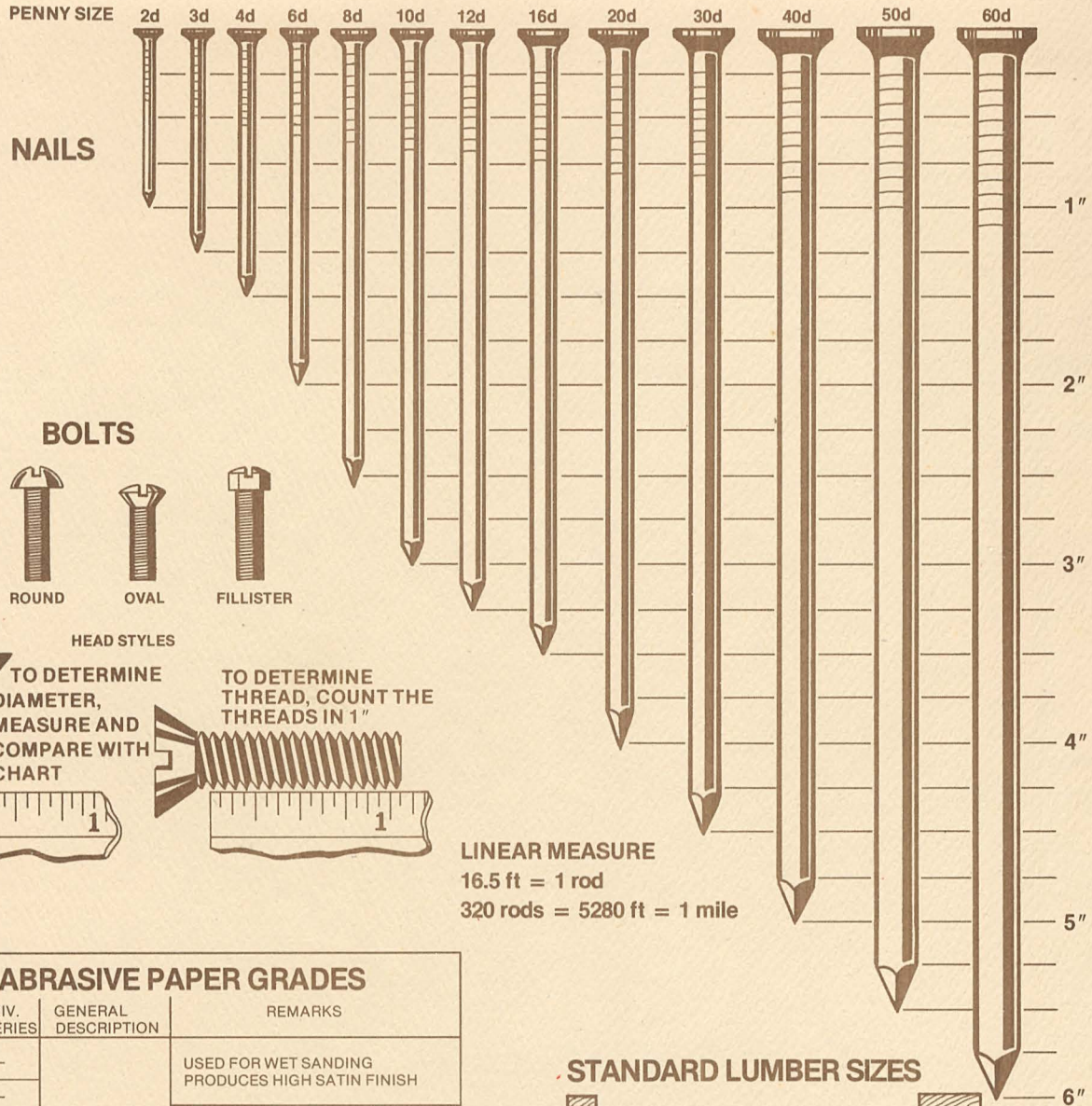
Popular Mechanics

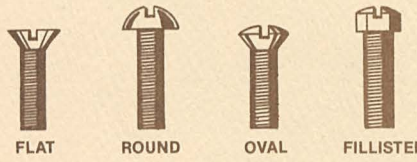
do-it-yourself yearbook 1982

SHOP GUIDE

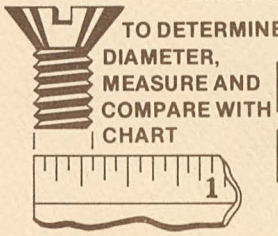
NAILS



BOLTS



HEAD STYLES



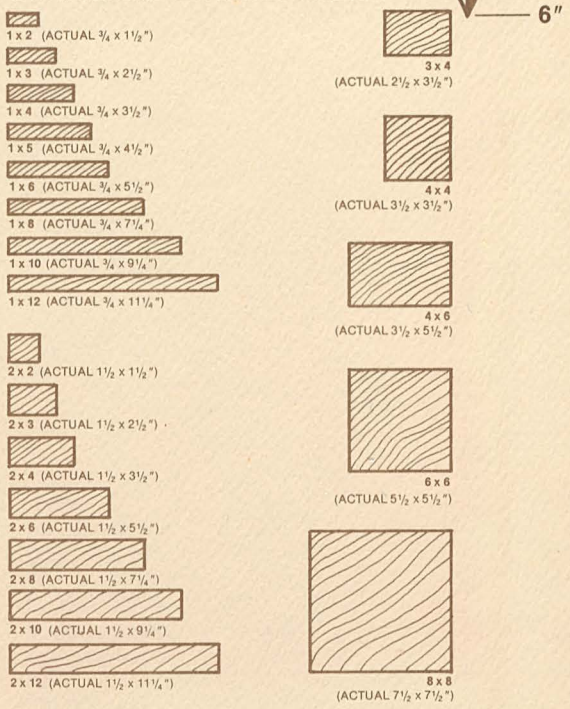
LINEAR MEASURE
16.5 ft = 1 rod
320 rods = 5280 ft = 1 mile

ABRASIVE PAPER GRADES

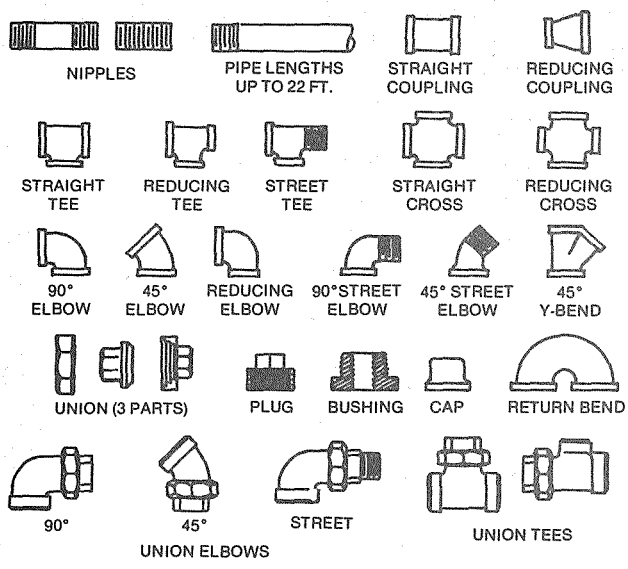
GRIT	EQUIV. "O" SERIES	GENERAL DESCRIPTION	REMARKS
600	—	SUPER-FINE	USED FOR WET SANDING PRODUCES HIGH SATIN FINISH
500	—		
400	10/0		GENERAL RANGE OF ABRASIVE PAPERS USED FOR WET SANDING LACQUER AND VARNISH TOP COATS
360	—		
320	9/0		
280	8/0	VERY FINE	USED FOR DRY SANDING ALL FINISHING UNDERCOATS. THESE GRADES WILL NOT SHOW SANDING MARKS
240	7/0		
220	6/0*		
180	5/0	FINE	FOR FINAL SANDING OF BARE WOOD. GOOD FOR SMOOTHING OLD PAINT
150	4/0*		
120	3/0	MEDIUM	USE FOR GENERAL WOOD SANDING. GOOD FOR FIRST SMOOTHING OF OLD PAINT, PLASTER PATCHES
100	2/0*		
80	1/0		
60	1/2*	COARSE	USE No. 1/2 FOR ROUGH-WOOD SANDING. No. 1 IS COARSEST PAPER WHICH CAN BE USED TO ADVANTAGE WITH PAD SANDER
50	1		
40	1 1/2		
36	2	VERY COARSE	ALL TOO COARSE FOR PAD SANDERS. THESE GRADES REQUIRE HEAVY MACHINES AND HIGH SPEED TO CUT WELL
30	2 1/2		
24	3		

Grades generally supplied as Very Fine, Fine, Medium and Coarse

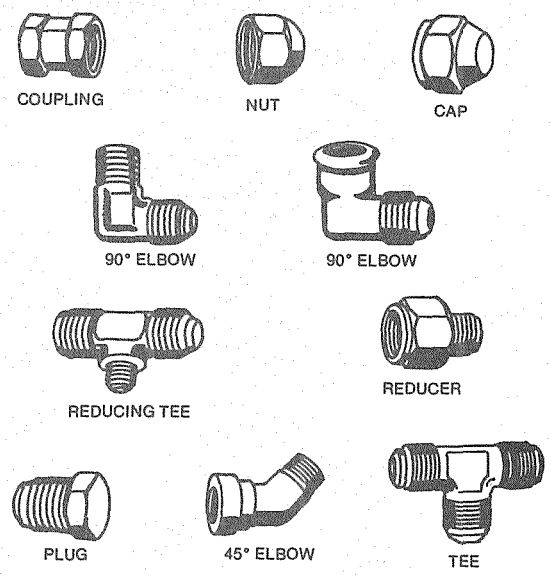
STANDARD LUMBER SIZES


1 x 2 (ACTUAL 3/4 x 1 1/2")
1 x 3 (ACTUAL 3/4 x 2 1/2")
1 x 4 (ACTUAL 3/4 x 3 1/2")
1 x 5 (ACTUAL 3/4 x 4 1/2")
1 x 6 (ACTUAL 3/4 x 5 1/2")
1 x 8 (ACTUAL 3/4 x 7 1/4")
1 x 10 (ACTUAL 3/4 x 9 1/4")
1 x 12 (ACTUAL 3/4 x 11 1/4")
2 x 2 (ACTUAL 1 1/2 x 1 1/2")
2 x 3 (ACTUAL 1 1/2 x 2 1/2")
2 x 4 (ACTUAL 1 1/2 x 3 1/2")
2 x 6 (ACTUAL 1 1/2 x 5 1/2")
2 x 8 (ACTUAL 1 1/2 x 7 1/4")
2 x 10 (ACTUAL 1 1/2 x 9 1/4")
2 x 12 (ACTUAL 1 1/2 x 11 1/4")
3 x 4 (ACTUAL 2 1/2 x 3 1/2")
4 x 4 (ACTUAL 3 1/2 x 3 1/2")
4 x 6 (ACTUAL 3 1/2 x 5 1/2")
6 x 6 (ACTUAL 5 1/2 x 5 1/2")
8 x 8 (ACTUAL 7 1/2 x 7 1/2")

PIPE FITTINGS



Here are the common steel pipe fittings. Nipples are simply short lengths of pipe threaded on both ends. Reducing fittings join two different sizes of pipe.



Compression fittings of the flared-tube type are the easiest for the novice to handle when working with copper tubing.

STANDARD STEEL PIPE
(All Dimensions in Inches)

Nominal Size	Outside Diameter	Inside Diameter	Nominal Size	Outside Diameter	Inside Diameter
1/8	0.405	0.269	1	1.315	1.049
1/4	0.540	0.364	1 1/4	1.660	1.380
3/8	0.675	0.493	1 1/2	1.900	1.610
1/2	0.840	0.622	2	2.375	2.067
3/4	1.050	0.824	2 1/2	2.875	2.469

SQUARE MEASURE

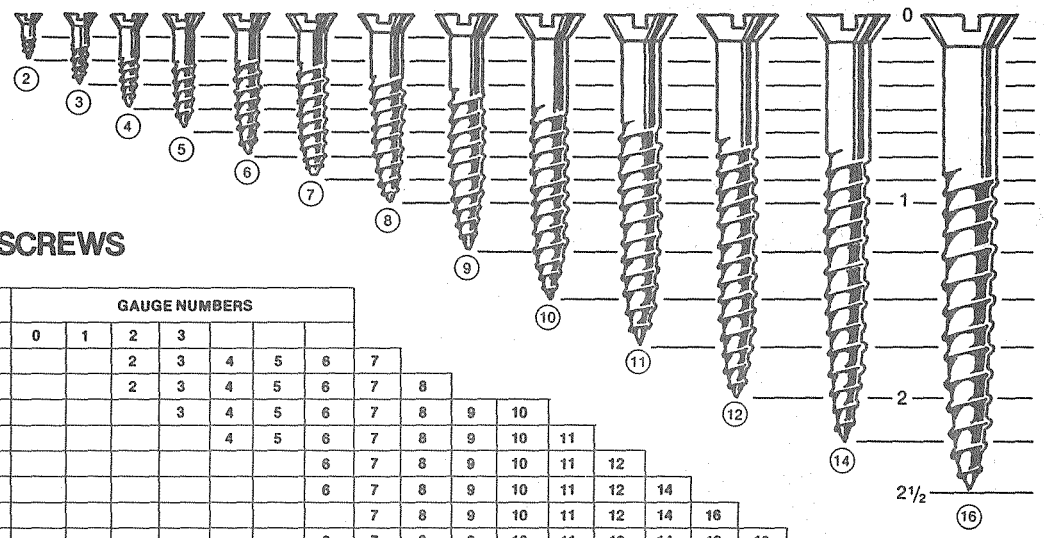
144 sq in = 1 sq ft
9 sq ft = 1 sq yd
272.25 sq ft = 1 sq rod
160 sq rods = 1 acre

VOLUME MEASURE

1728 cu in = 1 cu ft
27 cu ft = 1 cu yd

MEASURES OF CAPACITY

1 cup = 8 fl oz
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
2 gallons = 1 peck
4 pecks = 1 bushel



WOOD SCREWS

LENGTH	GAUGE NUMBERS																
1/4 INCH	0	1	2	3													
3/8 INCH			2	3	4	5	6	7									
1/2 INCH			2	3	4	5	6	7	8								
5/8 INCH				3	4	5	6	7	8	9	10						
3/4 INCH					4	5	6	7	8	9	10	11					
7/8 INCH							6	7	8	9	10	11	12				
1 INCH							6	7	8	9	10	11	12	14			
1 1/4 INCH								7	8	9	10	11	12	14	16		
1 1/2 INCH							6	7	8	9	10	11	12	14	16	18	
1 3/4 INCH									8	9	10	11	12	14	16	18	20
2 INCH									8	9	10	11	12	14	16	18	20
2 1/4 INCH										9	10	11	12	14	16	18	20
2 1/2 INCH													12	14	16	18	20
2 3/4 INCH														14	16	18	20
3 INCH															16	18	20
3 1/2 INCH																18	20	24
4 INCH																18	20	24

WHEN YOU BUY SCREWS, SPECIFY (1) LENGTH, (2) GAUGE NUMBER, (3) TYPE OF HEAD—FLAT, ROUND, OR OVAL, (4) MATERIAL—STEEL, BRASS, BRONZE, ETC., (5) FINISH—BRIGHT, STEEL BLUED, CADMIUM, NICKEL, OR CHROMIUM PLATED.

Popular Mechanics do-it-yourself yearbook 1982

For your home

- Exciting products for better living
- Projects to improve your home

For the craftsman

- Great craft projects of the year
- Shop projects and expert know-how
- The best of the new tools

For the outdoorsman

- Great new fishing, camping, boating and hunting gear
- Know-how tips from the experts

For the photographer

- Professional expertise
- What's new in photography

For electronics buffs

- Special projects in electronics
- Newsmakers in electronics

PLUS:

- Great projects just for fun
- A special section on energy-saving ideas

HEARST BOOKS 224 W. 57th St., New York, NY 10019

EDITOR	Clifford B. Hicks
ASSOCIATE EDITOR	Nancy Dills
ART DIRECTOR	Ralph Leroy Linnenburger
ASSISTANT EDITOR	Tom Balow
PHOTOGRAPHY	Joe Fletcher
ART ASSISTANT	Marian C. Linnenburger
CONTRIBUTING EDITORS	David Paulsen
	Benjamin Lee

POPULAR MECHANICS
EDITORIAL ADVISORY BOARD

John A. Linkletter, *Editor-in-Chief*
Joe Oldham, *Executive Editor*
Bill Hartford, *Managing Editor*
Harry Wicks, *Home and Shop Editor*
Ira Herrick, *Art Director*

Published by Hearst Books
A Division of The Hearst Corporation
224 West 57th Street
New York, N.Y. 10019

ISBN 910990-80-8
Library of Congress Catalog Number 75-648427

© 1982 The Hearst Corporation
all rights reserved

No part of the text or illustrations
in this work may be used without written
permission by The Hearst Corporation

Printed in the United States of America

The Hearst Corporation cannot assume responsibility for proper application of techniques, implementations or proper and safe functioning of any of the manufactured or reader-built items, products or projects resulting in whole or in part from all or any part of the plans, prints, projects or instructional materials published in this volume.

CONTENTS

great craft projects of the year
- Cradles with old-time charm 8
- Build a rugged garden cart 12
- A desk that never runs out of paper 16
- Build a perpetual desk calendar 19
- Two handsome hurricane sconces 21
- Make your own hammock 24
- Bright ideas in shop-made lamps 28

projects to improve your home
- A 'built-in' ironing center 32
- Build a cupola—the classic cooling system 37
- Great ways to use elegant, airy lattice 42
- How to hush a noisy house 46
- Build a back-yard utility shed 49
- Laundry in a closet 54
- From attic to family room 57
- Remodel the kitchen yourself—including the cabinets 63

exciting new home products
- Ingenious plug-in electrical extenders 69
- Automatic lawn feeder; clean water system 70
- Snap-together gutters and downspouts 71
- 14 products to shape up your pool 72
- 10 power-them-yourself yard tools 74

great energy-saving ideas
- 7 ways to get cheap firewood 76
- The art of burning wood to get more heat 77
- Be your own chimney sweep 80
- 5 ways to get more heat from a furnace 82
- Old-time shutters look geat—and save heat 85
- After 47,000 miles on gasohol—a clean engine 88

shop projects and expert know-how
- A bench for a craftsman (and one for a junior craftsman too) 90
- How water gets into your basement—and how to stop it 95
- How to buy and use a staple gun 99
- An expert's secrets for cutting glass 102
- Super storage for shop hardware 104
- You can patch almost anything with fiberglass 106
- How to hang anything on any wall 109
- Woodworking secrets from master craftsmen 114
- Do your own plumbing with plastic 118
- 4 great projects for your shop 122

the best of the new tools
- New for your shop 126

how-to for the outdoorsman
- Snowshoeing—old sport, new action 132
- Tabs can trim gas use in half! 134
- There's a hitch to towing with compacts 136
- Best knots for the new fishing lines 138

new for the outdoorsman
- New puff-up boats are tough 140
- The latest gear for snow sports 142
- Unusual accessories for campers 145
- Hot new .22s for better shooting 146
- For sports buffs 148

new for your car
- Great new products for auto buffs 150

projects just for fun
- The ultimate desk for the crayon set 152
- Great ways to say Merry Christmas 158
- Build a treetop hideaway for your youngsters 169

professional photo know-how
- 6 photo mistakes even the pros make 172
- Stop the action! 174

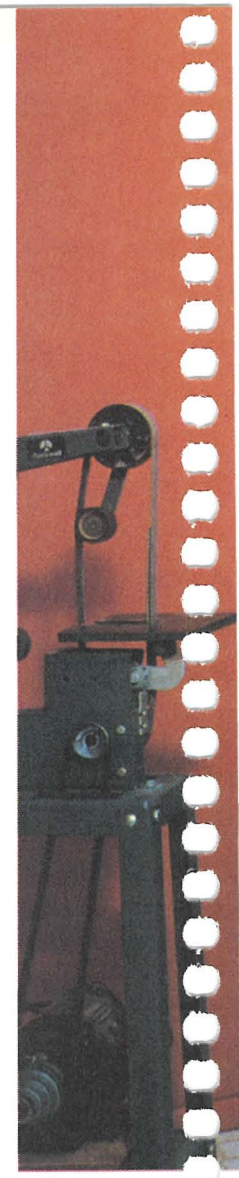
new for photographers
- Automatic cameras: more versatile than ever 177

fascinating projects in electronics
- Silence those nagging tv commercials 180
- Build a 'triple-header' auto voltmeter 183

newsmakers in electronics
- New mini TVs are entertainment centers 186
- Stereo is going digital 188

INDEX 191

TODAY'S TAKE-ALONGS offer much more than TV on the beach. Some have AM/FM radios, cassette players, even shortwave receivers, See the article on page 186.



On the following pages

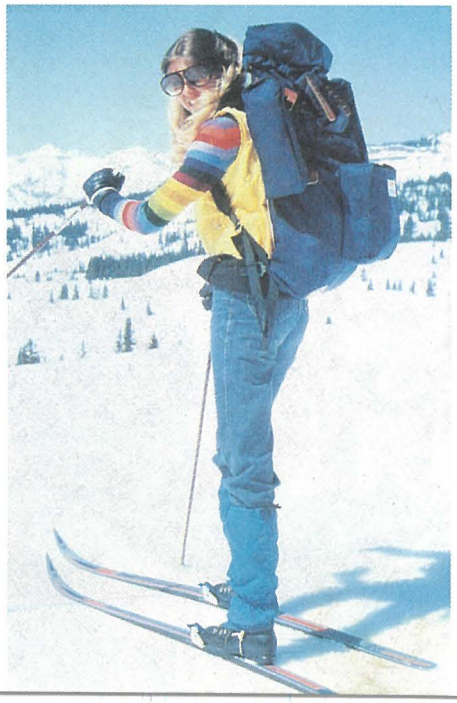
Exciting new products and handsome do-it-yourself projects

WITH TRIM TABS on the transom you can cut gas use by half! Learn how to use tabs on page 134.

HERE'S A SOLID little bench fit for a master craftsman. See the easy-to-build plans on page 90.

EVERY YOUNGSTER needs a hideaway, and this one is beautifully simple—an A-frame perched between two sturdy trees. Step-by-step plans start on page 169.

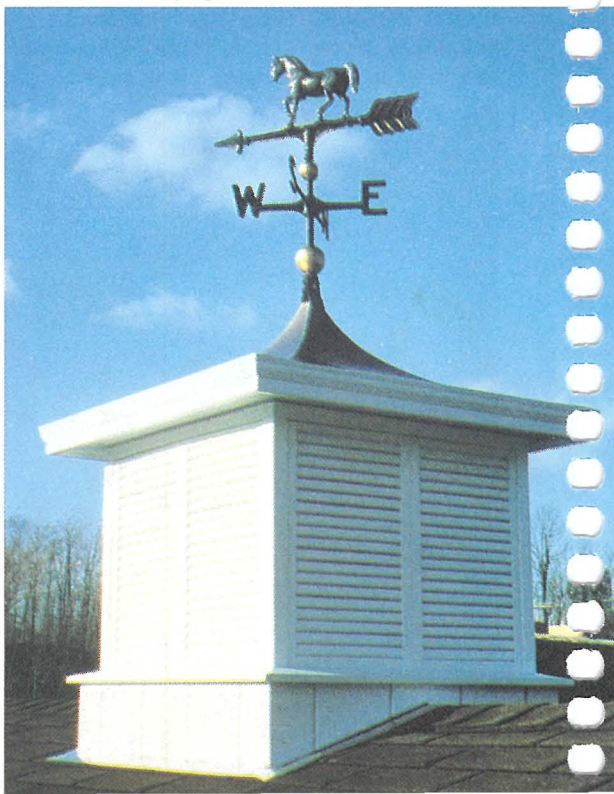
CROSS-COUNTRY skis have fish scales molded into center kick area. See more new winter gear on page 142.



HANDSOME UTILITY SHED stores tools, 3½ cords firewood, has a handy shop area. See plans page 49.

FOR FINE, decorative ways to use elegant and airy lattice, turn to page 42.

BUILD A CUPOLA—the classic cooling system. Our version on page 37 has a contoured roof.



SMART-LOOKING ironing center is "built-in," yet you take it with you if you move. It's easy to construct of ¾-in. plywood and readymade shutters. The plans start on page 32.

LATEST WINTER THRILL is streaking along the ice inside an airfoil sail. See page 142.

HANGING CRADLE is suspended with a strong cord.

COLONIAL TYPE can be rocked or held rigid with dowel.

Cradles with old-time charm

Build either the hanging or the standing colonial cradle for your infant's first bed

By HARRY WICKS

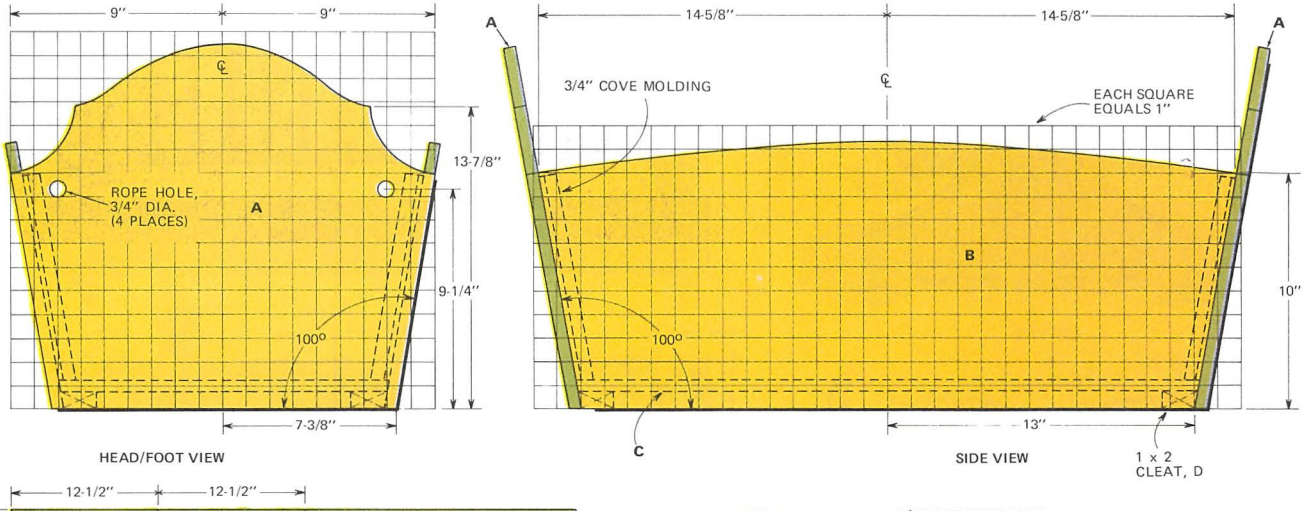
■ IN A LOT LESS time than you might suspect, you can add a touch of nostalgia to your nursery by building one of these plywood cradles. Whether you select the hanging cradle or the standing colonial type, you will have an attractive, economical and sturdy bed for your infant's first months.

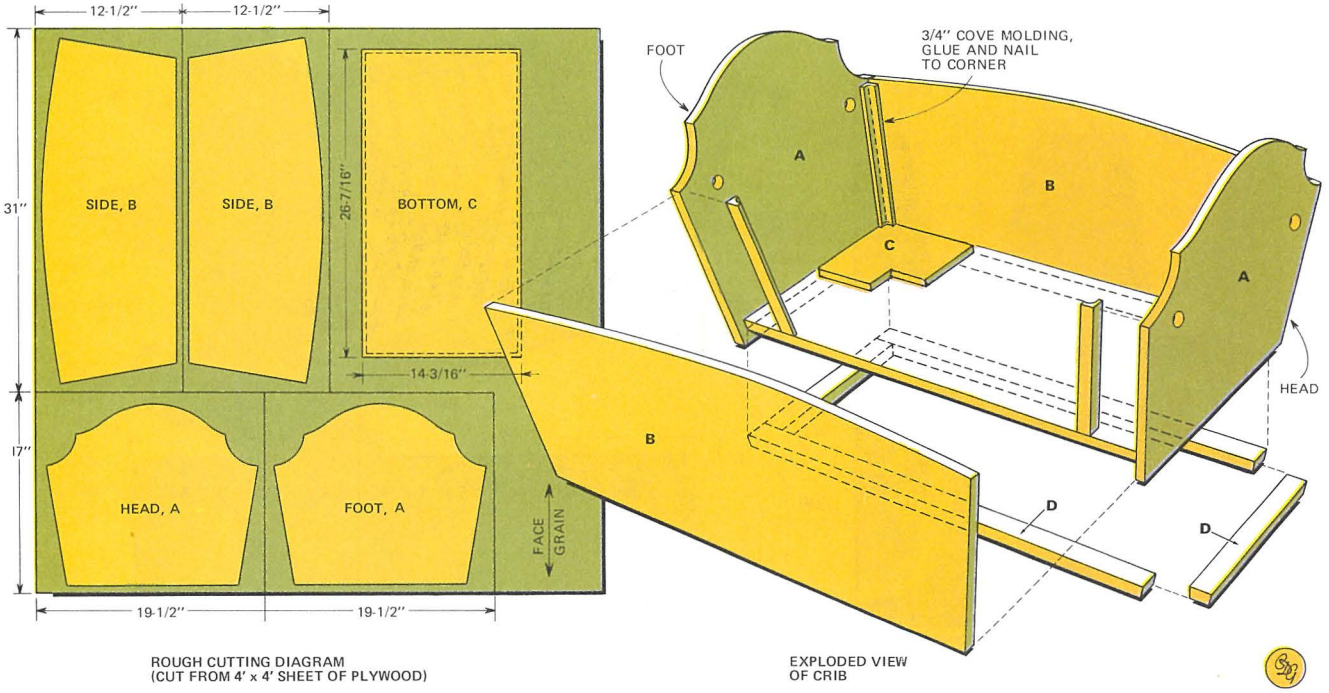
Designed by Julie Beck Ockfen and Tom Tavernor, these cradles will accommodate standard 13 x 28-in. foam basket pad mattresses or polyurethane foam sheets cut to size.

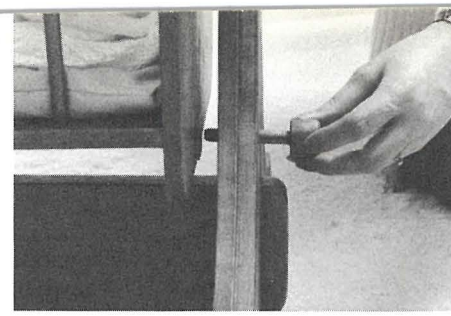
GENERAL DIRECTIONS

Constructed of a half-sheet of ½-in., APA grade-trademarked A-B, A-C, or MDO (medium density overlaid) plywood, some ¾-in. cove molding, glue and nails, you can build the hanging cradle easily in one shop session; the standing cradle takes somewhat longer to build.

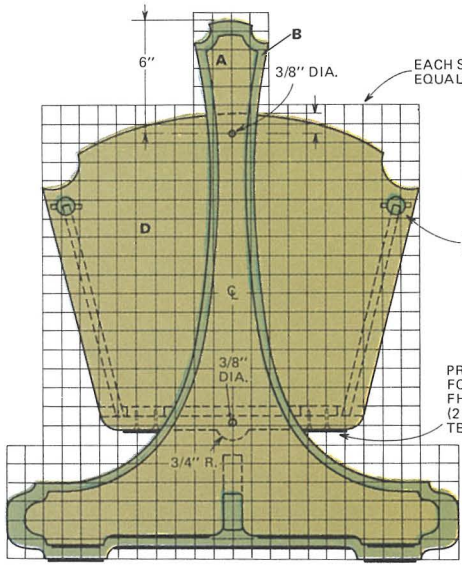
■ Use a portable circular, sabre or table saw to cut the plywood pieces to size. Cut with a smooth blade and position masking tape before cutting. Put the tape on the B side and cut with the A side



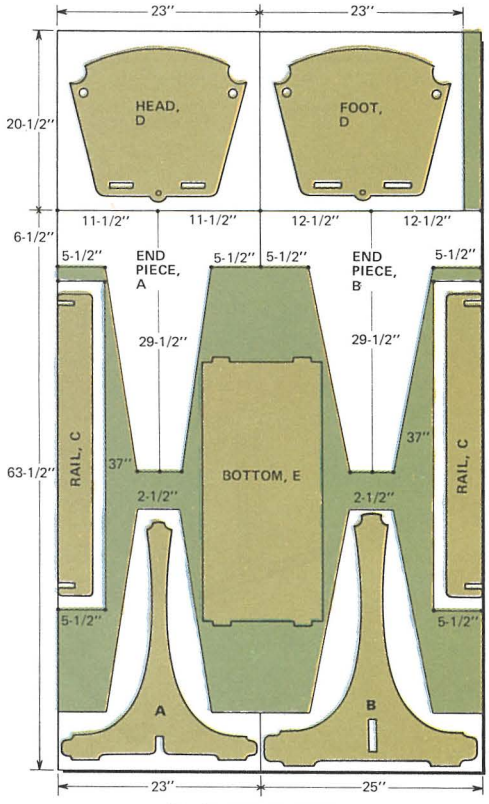




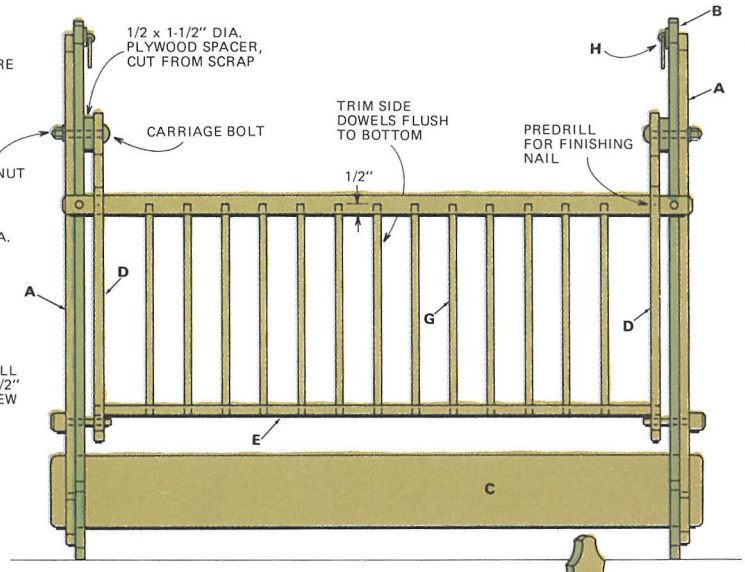
DOWEL LOCK PIN holds cradle rigid when desired. Clamp cradle to support to assure accuracy when you bore holes.



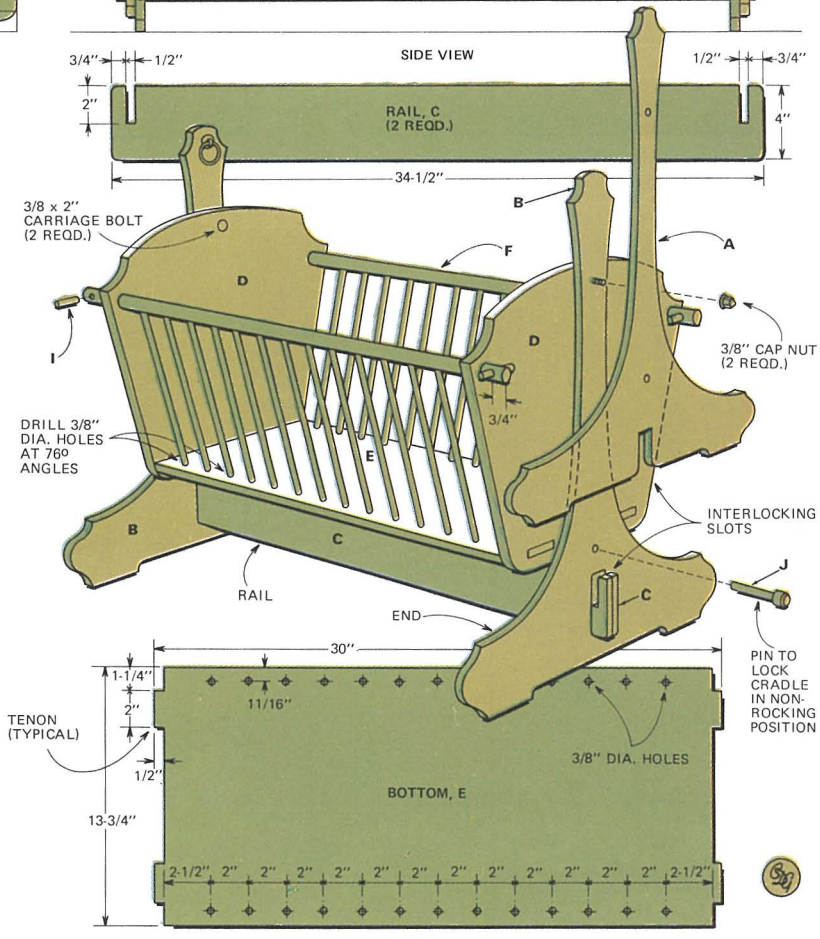
END VIEW



ROUGH CUTTING DIAGRAM
(CUT FROM 1/2" PLYWOOD)



SIDE VIEW



down with either a sabre or circular saw. On the table saw, cut with the A side up. Make all curved cuts with a scroll or bandsaw.

■ After all pieces are cut, check the edges, fill voids where necessary and sand smooth. Plywood faces need little sanding because these surfaces are drum-sanded at the mill. If you're working with a C surface, smooth it with belt and pad sanders.

■ If you plan to stain and varnish the cradles, choose a cabinet-grade plywood which will have a handsome grain on its surface veneer.

■ When your cradle is fully assembled, touch up any surfaces that aren't smooth with 150-grit sandpaper. Dust the piece and wipe with a tack cloth. Apply stain and let the cradle dry overnight.

Next day, apply a coat of 2-lb. cut, water-white shellac, thinned 50 percent with denatured alcohol. Let the shellac dry at least four hours. Then rub lightly with 180-grit paper, dust and tack off. Brush on a coat of varnish thinned slightly with turpentine. Allow this to dry overnight, at least, then sand the cradle lightly with a 200-grit paper wrapped around a soft sanding block, dust and tack off.

Finish by applying varnish as it comes from the can. Let the cradle cure for a week before use. Though a cradle is used when the baby is at an inactive age, take the precaution to use only nontoxic finishing materials. Check labels when buying.

THE HANGING CRADLE

Following the cutting pattern, lay out cradle parts on the half sheet of plywood. Temporarily tack cleats to the end and side panels and make a test assembly without glue. Modify dimensions if necessary, take apart and reassemble with glue and nails. Finish cradle as described above.

To hang the cradle, screw two enameled eye hooks (rated at 50 lbs.) into a ceiling joist. Thread ordinary marine line or a strong decorative cord through the holes in the cradle and the hooks. After knotting the line, unravel ends to make tassels.

THE EARLY-AMERICAN CRADLE

This cradle, which takes longer to build, can be stained, painted or antiqued. It requires slightly less than a full sheet of ½-in. plywood. If you have a 14 x 30-in. scrap of plywood handy you'll only have to buy a 4 x 4-ft. sheet. You'll also need dowels.

Cut the parts and assemble as shown in the drawing. Notice that both ends have two panels, making it a lot easier to assemble with rigidity; notched outside panels simply slip into the rail and lock it in place.

To assure accurate holes for the side rails, clamp both top dowels (F) in place on the cradle bottom and mark the dowel locations on both members at the same time. Make match marks on the dowels and cradle bottoms, so each dowel can be mated to its matching hole when you are assembling permanently.

Cut a plywood jig to guide your portable drill for boring the angled ⅜-in. holes in the cradle bottom. Use the same bit in your drill press to bore the holes in the dowels (F). Use the press depth stop to be sure you don't bore through the dowels. For accuracy, clamp the dowels in a V-block.

Assemble the cradle using glue and nails and set the assembly aside. You can also assemble the ends and rail with glue and nails.

The next day, position the cradle in its support and hold it in place with several handscrew clamps. Bore the pair of holes for the carriage bolt. Insert the bolts and secure with the cap nuts. Place the cradle on a level surface; the vertical end brackets should be at the center of the cradle. Insert some scrap material between the cradle end and support and clamp the unit rigidly. Bore the holes at one end (or both if desired) for the lock pin. Finish as described above.

MATERIALS LIST—HANGING CRADLE

Key	No.	Size and description (use)
A	2	½ x 15½ x 18″ plywood (head/foot)
B	2	½ x 11¼ x 29¼″ plywood (side)
C	1	½ x 14 3/16 x 26 7/16″ plywood (bottom)
D	4	¾ x 1½″ x length to suit, pine or fir (cleats)

Misc.: 4 pcs. ¾″ cove molding cut to suit, ½″-dia. rope, glue, 6d finishing nails.

MATERIALS LIST—COLONIAL CRADLE

Key	No.	Size and description (use)
A	2	½ x 2 x 28½″ plywood (end)
B	2	½ x 22 x 27″ plywood (end)
C	2	½ x 4 x 34½″ plywood (rail)
D	2	½ x 17¼ x 20″ plywood (head/foot)
E	1	½ x 13¾ x 30″ plywood (bottom)
F	2	1″-dia. x 33½″ dowel (guard)
G	26	⅜″-dia. x length to suit, dowel (baluster)
H	2	decorative pull rings
I	4	⅜ x 1″ dowel (pin)
J	2	¼ x 3″ locking pin, turn from round stock

Misc.: ½″ scrap plywood for 2 spacers, 2 ⅜″ x 2½″ carriage bolts, 2 ⅜″ cap nuts, glue, 4d finishing nails.

Build a rugged garden cart

Garden carts make all hauling easier. The removable rails on this one make it especially handy for hauling bulky loads, such as brush and bags of leaves or trash

GARDEN CARTS make yard and garden chores less of a strain. They can be used to move around everything from balled shrubs to cordwood.

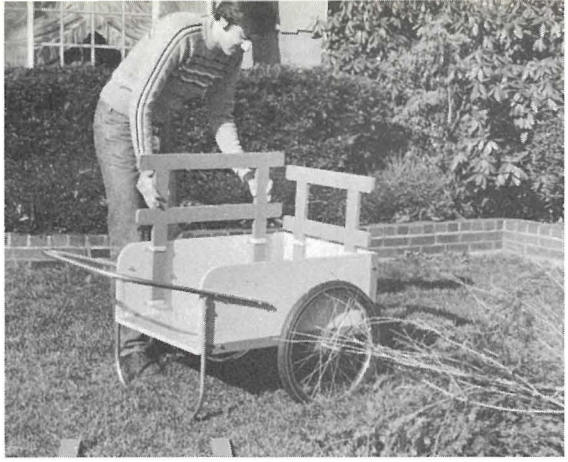
Our model has front and side extension rails to keep large loads, such as trash bags full of leaves or clippings, corralled. They can be quickly removed when they're not required.

We used 20-in.-dia. front bicycle wheels for the prototype, but a wheel kit, including semipneumatic tires and ¾-in.-dia. axle, is available for heavy-duty versions (see the materials list on page 14).

If you have a couple of old *front* bicycle wheels collecting dust, follow the instructions in the text for adapting them to the cart. The original wheel axles must be replaced with a single through-axle, which is not an item you can buy. It can, however, be readily made by threading the ends of a length of 5/16-in. cold-rolled steel rod, a stock item in many hardware stores.

Cut plywood parts (A, B and C) to size. Assemble the sides and bottom first and then add the front, using 4d finishing nails and resorcinol glue. Since the angle iron has a fillet (rounded

By AUGUST CAPOTOSTO



SIDE EXTENSIONS, which slip easily into brackets, nearly double capacity of the cart. They are especially useful for brush and bags of leaves or trash.

inside corner), round the corners of the box to permit the iron to make close contact with the wood.

The angle iron corner reinforcements (I, J, K) go on next. Note that the front bottom piece (I) is notched at the ends to allow a flush fit, without overlap, at the corner. Bore holes for the carriage bolts.

Attach the side angle irons (J) temporarily and then cut the axle brackets (L) from the same stock. Bore holes for the axle and bolts. Insert the axle into the brackets and place the assembly onto the bottom of the box.

Be certain you carefully align the axle parallel to the front, and mark the holes for the bolts on the angle iron by tracing through the predrilled holes in the brackets.

The two, wooden, axle-support blocks (G) are cut from 2 x 3s. These serve to prevent the axle from bowing under load. Make sure the holes in these blocks are at the same height as those in the brackets. Adjust location and axle-hole diameter shown in the plans if you use the heavy-duty wheel kit with ¾-in. axle. Brackets are not required if you use the heavy-duty axle.

Next, cut the axle (Q) to length and cut the threads at each end (if you're using bicycle wheels). Note that axle thread size is not standard; some wheels have axles with 24 threads, and others have 26 threads per in. The cones which retain the wheel bearings will, accordingly, have either of these threads.

The 5/16-24 NC thread die is a common one, usually found in home-shop threading kits. The 26-thread die is not that common, and most local hardware stores do not stock it. Check the wheel-hub threading before assuming you can use the wheels you have on hand.

Assemble the parts thus far completed with the appropriate bolts, but don't overtighten. You may want to dismantle the angle iron members so that you can do a neat, two-tone paint job of the entire garden cart later.

The extension rails are made with half lap joints, which can be cut with a few passes over a dado head. Use glue to join the parts.

To make the stake retaining brackets (M), cut 12 steel strips to length. Then mark the four bend locations as indicated in the plan. Line up the mark for the first bend with the top edge of the vise jaw. Press sideways with scrap wood to form a right-angle bend. Then make the next bend to form a U-shape. Now, reinsert the pieces in the vise up to the second mark and make reverse right-angle bends. Drill holes for the roundhead screws in the brackets and pilot holes in the cart sides. Install the brackets.

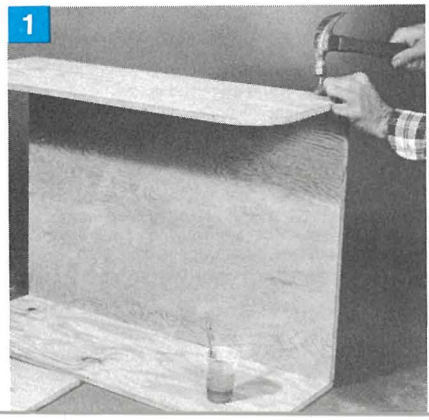
The aluminum tubing for the cart handle (O) and stand (P) can be easily bent to shape with the simple jig shown in the plans and photos. However, in order to come up with U-shaped tubes with the proper inside-to-inside dimension, the bend marks must be spaced accurately and lined up carefully with the index marks on the jig.

Insert 12-in.-long dowels into the ends of the tubes to reinforce them at the bolts which join them to the cart sides. Drill the holes and install.

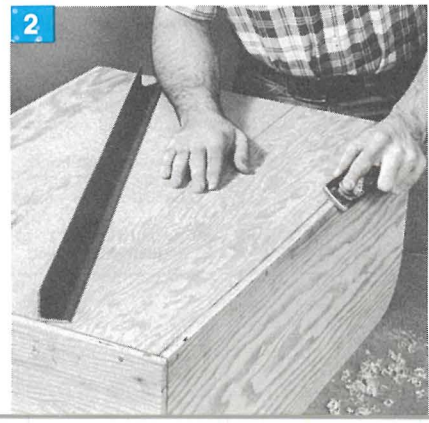
garden cart continued on next page

HOW TO BUILD THE GARDEN CART

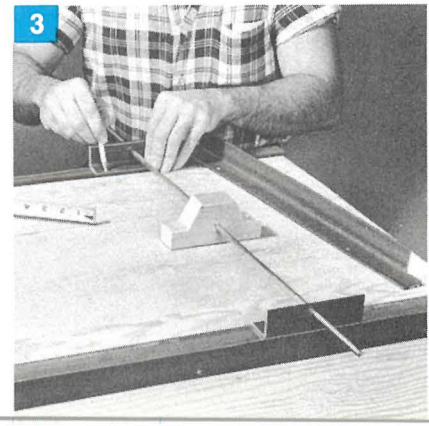
USE waterproof resorcinol glue and 4d (1½-in.) finishing nails to put together the three-sided body of the cart.

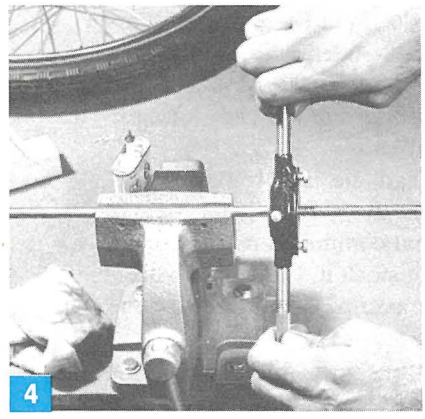


DUE TO FILLET in angle iron crease, round the outside corners of the box with a block plane or rasp for close fit.

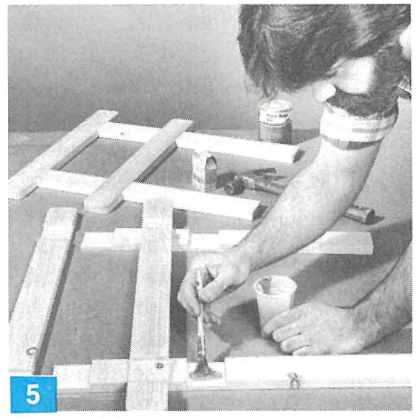


POSITION AXLE brackets, with predrilled holes, over the bottom angle irons to mark locations for the holes.

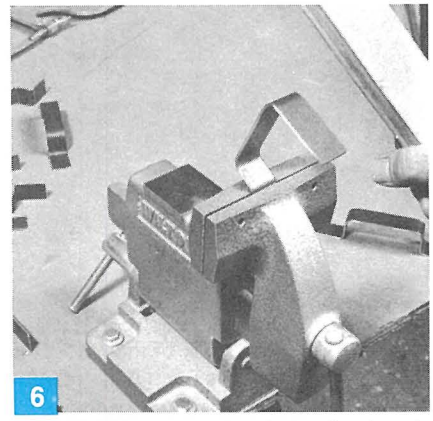




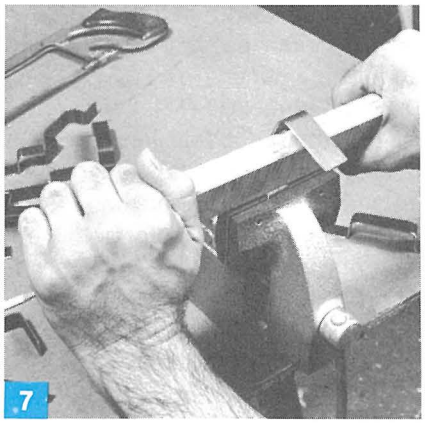
IF YOU USE bike wheels, cut deep threads on both ends of a 5/16-in.-dia. rod. Use die to match threads in wheel.



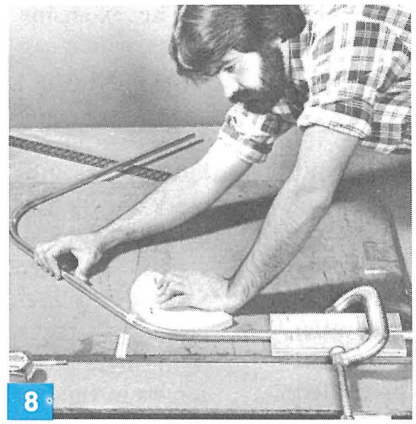
WHEN ASSEMBLING side and front rails, use ¾-in. galvanized brads, four on each side, to hold glue joint.



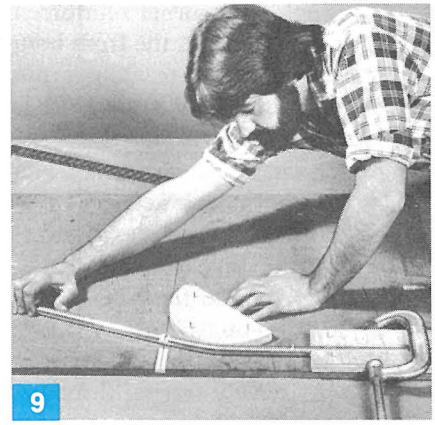
TO MAKE the stake brackets, first bend steel strips into U-shapes in a vise; then bend the flanges at each end.



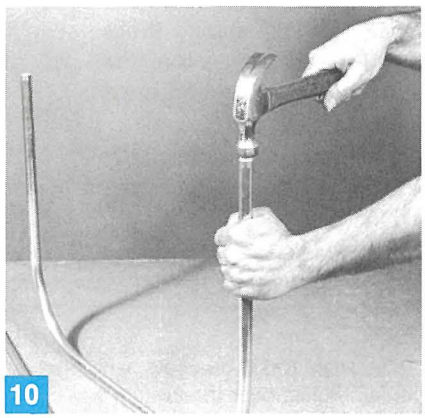
TO FINISH the flange bend on each leg, press the flange firmly with a scrap of wood while it is held in a vise.



MAKE this jig to bend the aluminum tubing. Index marks on the backboard and tube align for proper bending.



THE SECOND BEND will form a U of correct width only if the second index mark was properly spaced.



DRIVE HARDWOOD dowels into the ends of tubing for reinforcement. The ⅝-in. dowels require sanding to fit.

Construct a cart that will last

Since you're not likely to wheel your cart into the shed or garage every time it rains, take the following precautions to prolong its useful life:

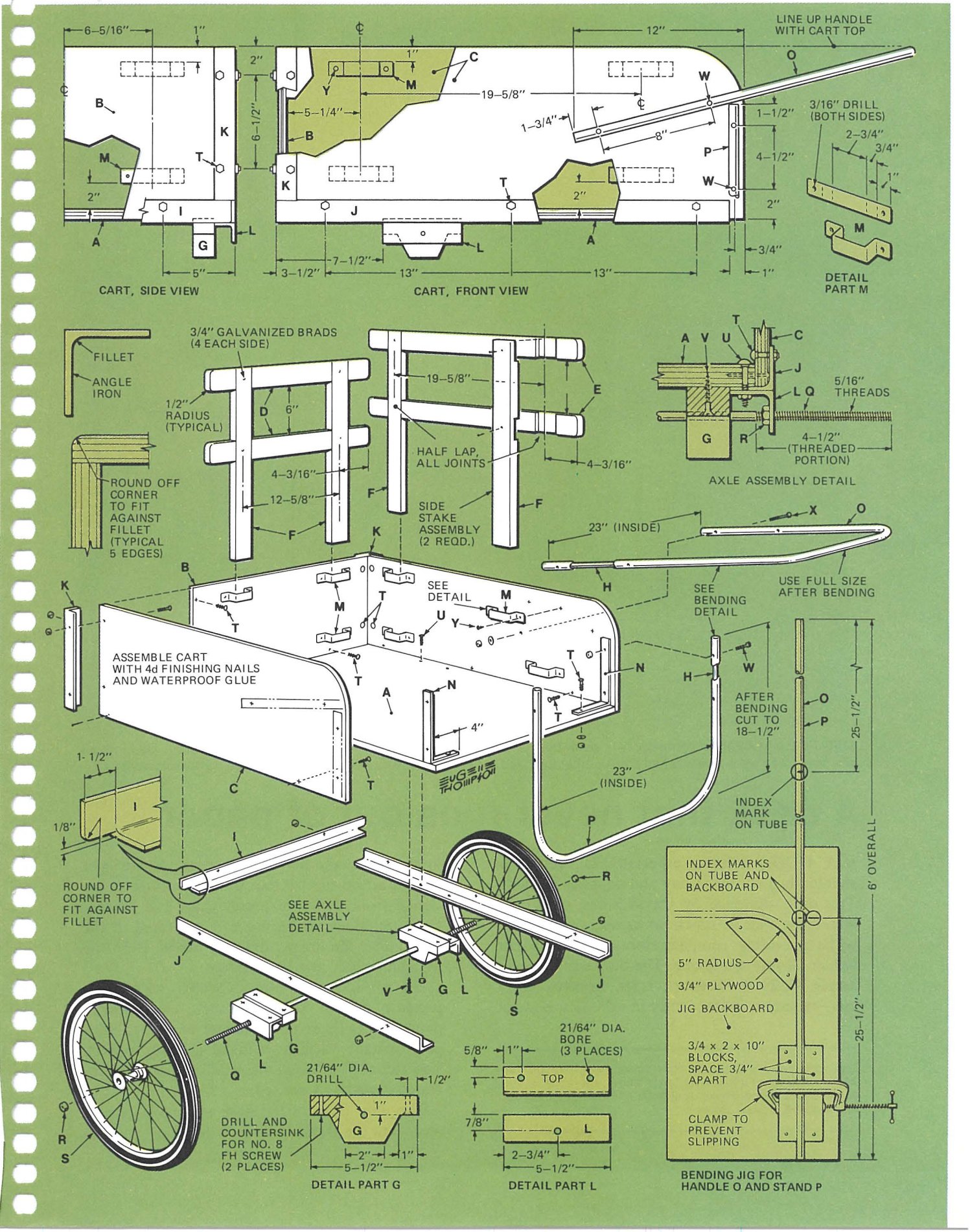
1. Use only exterior-grade plywood.
2. Use two-part, resorcinol glue, available at good hardware stores, for all wood joints.
3. Use brass or galvanized metal fasteners. Ordinary steel will rust quickly and stain the wooden parts.
4. Be sure to paint unprotected metal parts with a rust-inhibiting primer and a compatible enamel top coat. Aluminum tubing need not be painted.
5. Seal all wood parts with a latex exterior primer.
6. Use an exterior latex enamel for the top coat. Spar varnish can be applied over the latex if an extra-durable gloss finish is desired.

MATERIALS LIST—GARDEN CART

Key	No.	Size and description (use)
A	1	¾ x 22 x 32″ plywood (cart bottom)
B	1	½ x 12 x 23″ plywood (cart front)
C	2	½ x 12 x 32″ plywood (cart side)
D	2	¾ x 2⅜ x 21″ (front extension rails)
E	4	¾ x 2⅜ x 28″ (side extension rails)
F	6	¾ x 2⅜ x 22½″ (extension posts)
G	2	1½ x 2½ x 5½″ fir (axle brace)
H	4	⅝″-dia. x 12″ dowel (insert)
I	1	⅛ x 1½ x 1½ x 23″ (angle iron for bottom front)
J	2	⅛ x 1½ x 1½ x 31½″ (angle iron for bottom sides)
K	2	⅛ x 1½ x 1½ x 10½″ (angle iron for front edges)
L	2	⅛ x 1½ x 1½ x 5″ angle iron (axle support)
M	12	1/16 x 1 x 6¼″ steel (bracket)
N	2	1/16 x 1 x 11½″ steel (braces)
O	1	¾″ o.d. x 72″ aluminum tubing (handle)
P	1	¾″ o.d. x 72″ aluminum tubing (stand)
Q	1	5/16″-dia. x 31¼″ steel rod (axle)*
R	4	5/16″ hex nuts (axle nuts)*
S	2	20″-dia. front bicycle wheels*
T	18	¼ x ¾″ carriage bolt, washer and nut
U	4	5/16 x 1½″ carriage bolt, nut (4 reqd.)
V	4	1½″ No. 8 fh wood screw
W	4	¼″ x 1½″ hex-head bolt, nut
X	4	¼″ x 1½″ hex-head bolt, washer and nut
Y	24	½″ No. 8 pan-head screw

Misc.: 4d finishing nails; ¾″ galvanized brads; resorcinol glue; scrap lumber for bending jig.

* Heavy-duty wheel and axle kit, including semipneumatic tires and a ¾″-dia. axle, is available from J.H.B. Kits, 10405 Wallace St., Kansas City, MO 64134. The 20-in. front bike wheels, with 5/16-24 axle components, can also be purchased from Sears, Roebuck and Co.


CART, SIDE VIEW
CART, FRONT VIEW
DETAIL PART M
LINE UP HANDLE WITH CART TOP
3/16" DRILL (BOTH SIDES)
FILLET
ANGLE IRON
3/4" GALVANIZED BRADS (4 EACH SIDE)
1/2" RADIUS (TYPICAL)
ROUND OFF CORNER TO FIT AGAINST FILLET (TYPICAL 5 EDGES)
HALF LAP, ALL JOINTS
SIDE STAKE ASSEMBLY (2 REQD.)
AXLE ASSEMBLY DETAIL
5/16" THREADS
4-1/2" (THREADED PORTION)
23" (INSIDE)
USE FULL SIZE AFTER BENDING
SEE BENDING DETAIL
ASSEMBLE CART WITH 4d FINISHING NAILS AND WATERPROOF GLUE
SEE DETAIL
AFTER BENDING CUT TO 18-1/2"
INDEX MARK ON TUBE
6' OVERALL
ROUND OFF CORNER TO FIT AGAINST FILLET
SEE AXLE ASSEMBLY DETAIL
INDEX MARKS ON TUBE AND BACKBOARD
5" RADIUS
3/4" PLYWOOD
JIG BACKBOARD
3/4 x 2 x 10" BLOCKS, SPACE 3/4" APART
CLAMP TO PREVENT SLIPPING
BENDING JIG FOR HANDLE O AND STAND P
21/64" DIA. DRILL
DRILL AND COUNTERSINK FOR NO. 8 FH SCREW (2 PLACES)
DETAIL PART G
21/64" DIA. BORE (3 PLACES)
TOP
DETAIL PART L

THIS GOOD-LOOKING, contemporary desk boasts a built-in paper holder which lets children roll out a clean sheet whenever they want. There is storage for other supplies beneath the lift-up drawing board, and inside the rollabout chair.

A desk that never runs out of paper

■ A GOOD DESK, especially an art desk, should keep clutter at bay and supplies at hand. This desk, designed by David Stiles, does both admirably well: It functions as a drawing table, while providing compact storage and a paper holder all rolled into one. The desk surface is an ample 16x24 in. Scissors, ruler, brushes, crayons—whatever is frequently in use—can be kept in the bin at the head of the desk. A narrower trough at the foot of the drawing surface is designed to hold jars of poster paint and prevent spills. Supplies not in use can be stored in the desk under the hinged drawing board. Even the matching chair provides storage.

All surfaces are either covered with high-pressure plastic laminate, such as Formica, painted with high-gloss enamel or coated with polyurethane varnish to make cleanup a snap. You can also substitute the enamel paint for laminated surfaces, if desired.

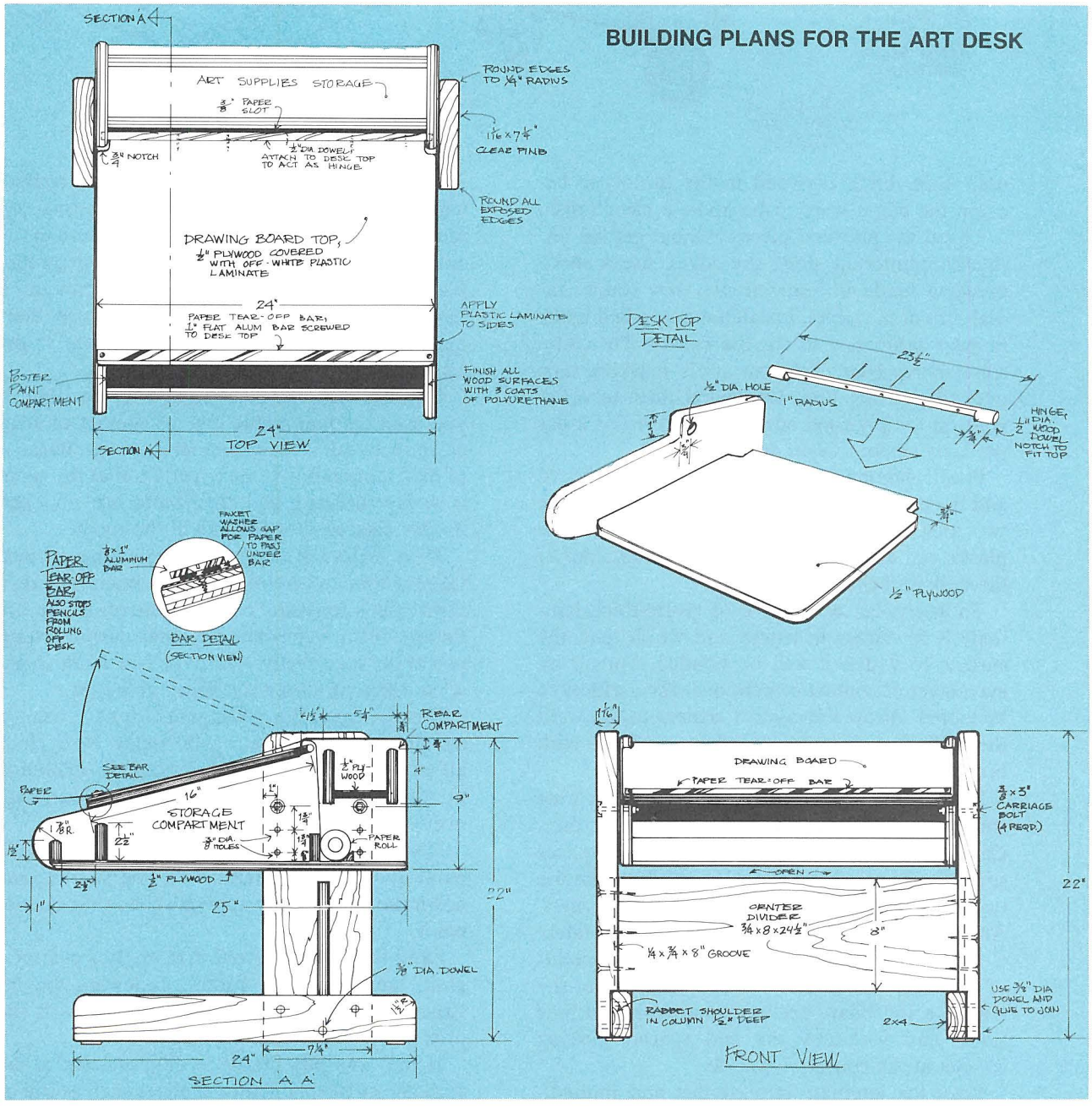
The only parts of the desk not made of plywood are the stand—which is of pine—and the

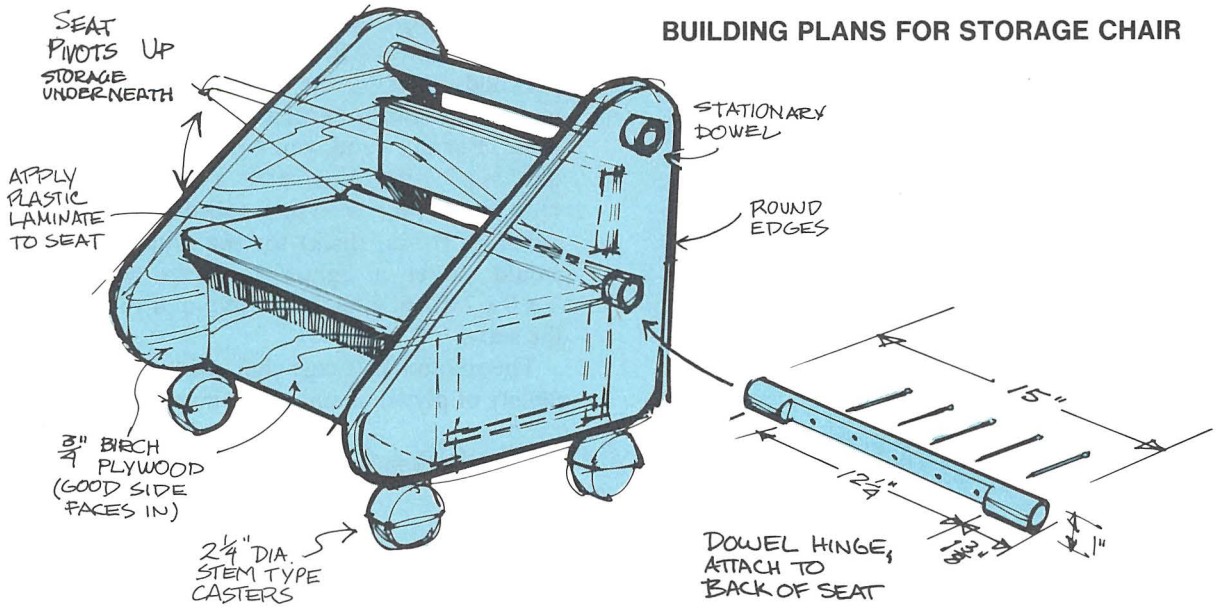
The contemporary chair and desk designs are from *Easy-to-Make Children's Furniture* by David Stiles. The book is published by Pantheon Books, a division of Random House Inc. and is $7.95 at book stores.

MOST ART and stationery stores sell cheap drawing paper in rolls. The 16-lb. bond poster-paper roll we used is 18 in. wide and 25 yds. long.

desk top hinge, made with a ½-in.-dia. dowel. Careful cutting will allow you to get all of the plywood pieces for the desk from a ½ x 48 x 48-in. sheet of A-C fir or birch veneer solid-core plywood. For the stand, you will need a 4-ft. length of 11/16 x 7½-in. pine and a 4-ft. length of 1½ x 3½-in. pine. You may substitute ¾-in. stock (actually 11/16-in. thick) for the desk feet if you would prefer a lighter look. In addition, a ¾ x 8 x 24½-in. stretcher is required to complete the stand.

The rollabout storage chair can be made completely of plywood and two 1-in-dia. dowels. We





BUILDING PLANS FOR STORAGE CHAIR

used ¾-in. birch plywood in the prototype because the edges were to be given a clear finish.

To cut the plywood pieces without getting unsightly splintering along the edges, use a sharp plywood blade in your circular saw (table, radial-arm or portable). Install a fine-toothed blade in your sabre saw to cut the curves. To assure splinter-free edges you can apply masking tape over the cutting line. Use wood filler to cover voids in the plywood edges. Sand all filled areas perfectly smooth when dry.

Plastic laminate on both the drawing board and the desk seat makes a lot of sense since these two areas are subject to the most abuse. The plastic can also be used on the exposed sides of the desk and chair.

To apply, cut each piece of 1/16-in.-thick laminate ¼ in. larger in length and width than the surface to which it will be bonded. Spread an even layer of contact cement over the surfaces to be mated. Allow the contact cement to dry until the adhesive doesn't lift when touched with brown paper.

Next, place clean dowels, or ¾ x ¾-in. pine sticks, about 12 in. apart on the plywood surface. Carefully lower the laminate onto the spacer sticks, being careful to avoid contact between the two glued surfaces. Start at one of the corners. Align the corner so that there is approximately ⅛-in. overhang on both sides, make a final check of the other two sides—to make certain that the laminate and board are in alignment on all four sides—and withdraw the end spacer, making contact at the corner as you do.

Press the laminate into contact and immediately work your way across the board, pulling stick-spacers and pressing laminate into contact with plywood as you go. As soon as all sticks are removed, apply a good amount of pressure to the entire bonded surface. Use either a wooden roller (i.e., rolling pin) or a clean block of wood and a hammer to provide the clamping pressure. Start applying pressure to the bonded surface at the center and work toward the edges.

Cleanup can take place right after bonding. If you used the flammable type of contact cement, cleanup is with lacquer thinner and rags. Because of high flammability, make certain that the room is well ventilated and that there are no open flames, cigarettes or the like in the room.

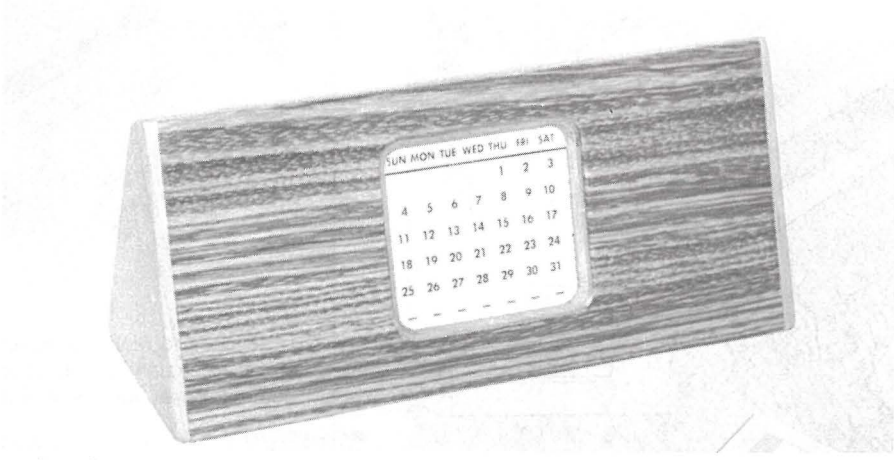
Note: Before starting any laminating project, take the time to carefully read the manufacturer's instructions for using contact cement. If you opt for one of the water-based cements, make certain you apply it correctly. This type is worked somewhat differently than the flammable type.

Finally, trim all overhanging laminate, using a straight carbide cutter in your router. Next, since all edges should be slightly rounded—including the thin laminate—use a small-radius rounding-over bit in the router.

If you build this furniture with the idea of all paint and no plastic laminates, you should tone down the grain before applying the prime coat of paint.

Sand the raw wood and then apply a coat of a grain tamer, such as Firzite, following the instructions on the can. Then proceed with the prime- and finish-coat painting steps.

If you can't buy Firzite locally, seal and prime with one of the pigmented shellacs such as Bin or Enamelac.



Build a perpetual desk calendar

By FRANK H. DAY

THIS DESK calendar never needs replacing. Cut face from bottom of this page.

■ THE DATING SYSTEM of this calendar is designed so it can be used forever. The calendar front is ⅛-in. lauan plywood surfaced with zebra-wood veneer, while the ends are solid cherry.

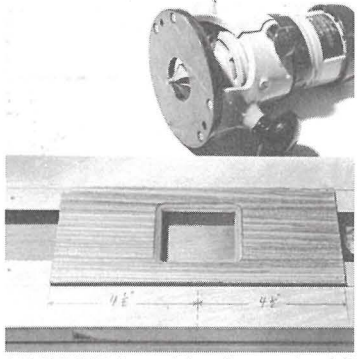
You can make the front and the number slider of any plywood or hardwood to match your decor. You'll need about one sq. ft. of this wood. Make the ends of hardwood (½ x 2½ x 7-in. piece) and the other parts of any solid wood.

Begin by carefully cutting the calendar from this page. Cut the front (A) and rough cut the window opening slightly undersize with a jigsaw or sabre saw. Use a jig to cut a bevel edge, front to back, on the window. First, center A in the jig, using the marked guidelines, and tack its corners with brads. Use a 45° bevel router bit with bearing guide. Adjust the bit for a 3/16-in. depth of cut. Insert the router bit into the opening and allow the pilot to follow the opening in the jig. Test on scrap wood first. After making the cut, remove the piece and sand the edges.

Next, cut stock to a 5/32-in. thickness for the upper (C), lower (D) and end (E) spacers. Use rubber cement on both surfaces to mount the narrow paper strip (with the days of the week) on C. Cover the paper with clear adhesive film. Use white glue to secure C, so the print is properly aligned at the top of the window.

Cut the slider (B). Then cement the numeral sheet to B and cover with clear adhesive. Position the slider; then glue in the lower spacer (D), so slider can move freely.

Glue in the end spacers (E). To position them, place B behind the window, with No. 1 at the left edge of the window. This is the slider's left limit of travel. Repeat with No. 1 at the right-hand window edge.

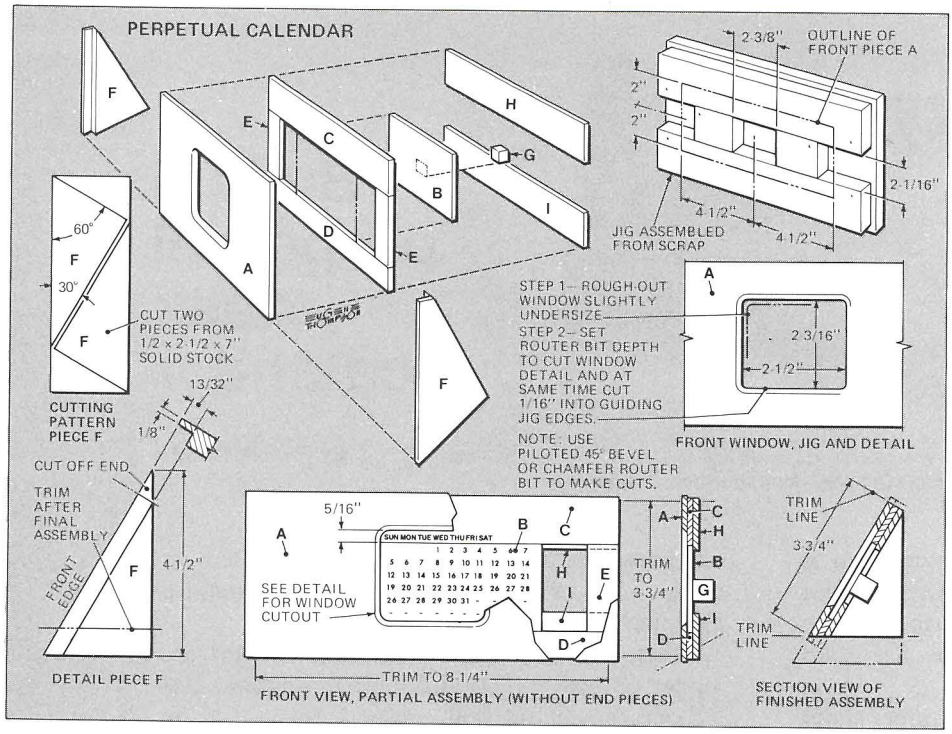


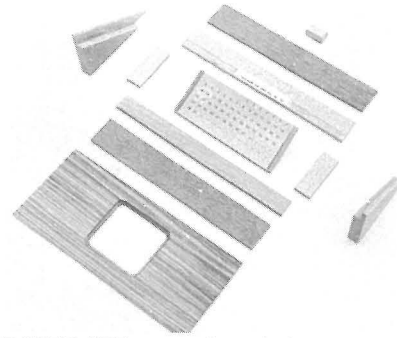
AN INNER jig guides the router bit when you bevel cut around the window in piece A.

THE FACE can be cut as shown below or duplicated on a copying maching. Separate upper and lower sections with a single, straight cut.

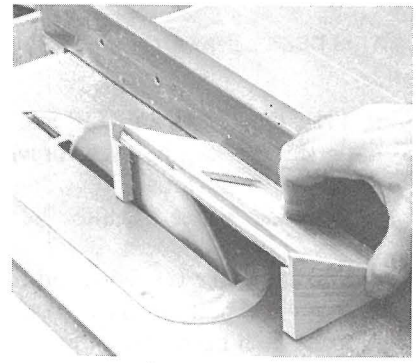
Cut along dotted lines

SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
—	—	—	—	—	—	—





PARTS ARE cut and ready for assembly. Attach the days and numbers with rubber cement, cover with clear film.



AFTER THE GLUE at side joints dries, place the stand face up, with top against the rip fence; trim bottom edge.

Cut the remaining parts. Clamp back strips (H and I) on the assembly for a trial front-to-back fit of the slider. If B fits too loosely, sand the back of the spacer strips. If it is too tight, sand its back. Glue G, H and I in place.

Trim the ends of the assembled front to size and attach end blocks (F) with glue. After the glue has dried, trim the bottom of edge A.

The stand is ready for final sanding and finishing. Oil the wood sparingly, then wax it. Varnish is not recommended as it may hinder the action of the slider.

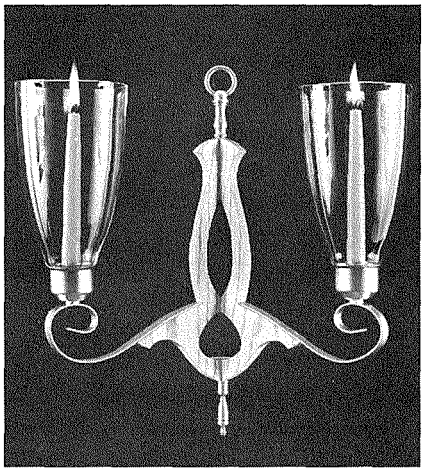
Now the calendar is ready to use. For a given month, just move the slider until the number 1 is under the proper day of the week.

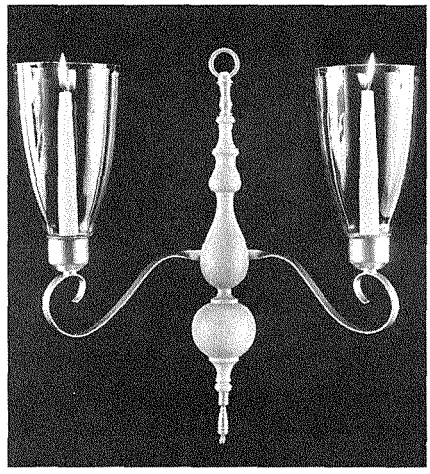
MATERIALS LIST—DESK CALENDAR

Key	No.	Size and description (use)
A	1	⅛ × 4 × 9″ plywood or hardwood (front)
B	1	⅛ × 2⅛ × 5¼″ plywood or hardwood (slider)
C	1	5/32 × 1⅛ × 9″ solid wood (upper spacer)
D	1	5/32 × ⅝ × 9″ solid wood (lower spacer)
E	2	5/32 × ¾ × 2⅛″ solid wood (end spacer)
F	2	½ × 2½ × 7″ solid wood makes both pieces (end blocks)
G	1	½ × ½ × ½″ solid wood (knob)
H	1	⅛ × 1¼ × 9″ solid wood (top runner)
I	1	⅛ × 1⅛ × 9″ solid wood (bottom runner)

Misc.: Brads; white glue; sandpaper; clear film, such as Contact; rubber cement; Danish oil and wax or other finish.

THIS AREA TO BE CLIPPED OUT
SEE PREVIOUS PAGE





Two handsome hurricane sconces

By ROSARIO CAPOTOSTO

■ ACCENT A WALL with glowing candlelight with one or two of these graceful fixtures. They would also make great gifts. Your outlay will be about $15 each.

Appealing to a broad range of home craftsmen, we offer two designs. The spindle sconce requires a lathe; the scroll sconce can be cut with a jigsaw, bandsaw, sabre saw or coping saw. Metalwork is basically the same for each design.

It would be desirable to use solid-brass components, but a complete set of compatible brass parts is unavailable. Therefore, a mixture of brass, brass-plated and plain steel is used. A brass spray-on coating easily solves the problem. We used white oak for the prototype lamps.

making a scroll sconce

Make a full-size pattern of the outline by drawing ½-in. squares on paper. Plot the design freehand and smooth curves using a French curve. Transfer the outline to two pieces of ½-in. stock. Cut the double bevel on one edge of each piece. Be sure to cut a matching left and right bevel in relation to the face side of the stock. Then tack-nail the pieces together and saw both at the same time. Sand edges smooth, then separate the pieces and finish sand the surfaces.

To join sections, glue and butt the front bevels together using two small blocks to hold the assembly at the required angle. When glue has set, turn over the piece and glue in the two bevel-faced reinforcing blocks. Bore an angled hanging hole into the back of the upper block.

Scrolled arms are made of mild-steel bar stock, easily curved to shape with a simple forming jig. To make the jig, draw a full-size pattern of the strip-forming block on ½-in.-thick hardwood and cut it out with a jigsaw or sabre saw. Note that the metal strip must fit snugly in the starting slot to minimize the chance of its sliding out as you start the bend. Glue the forming block onto a scrap-block base of plywood.

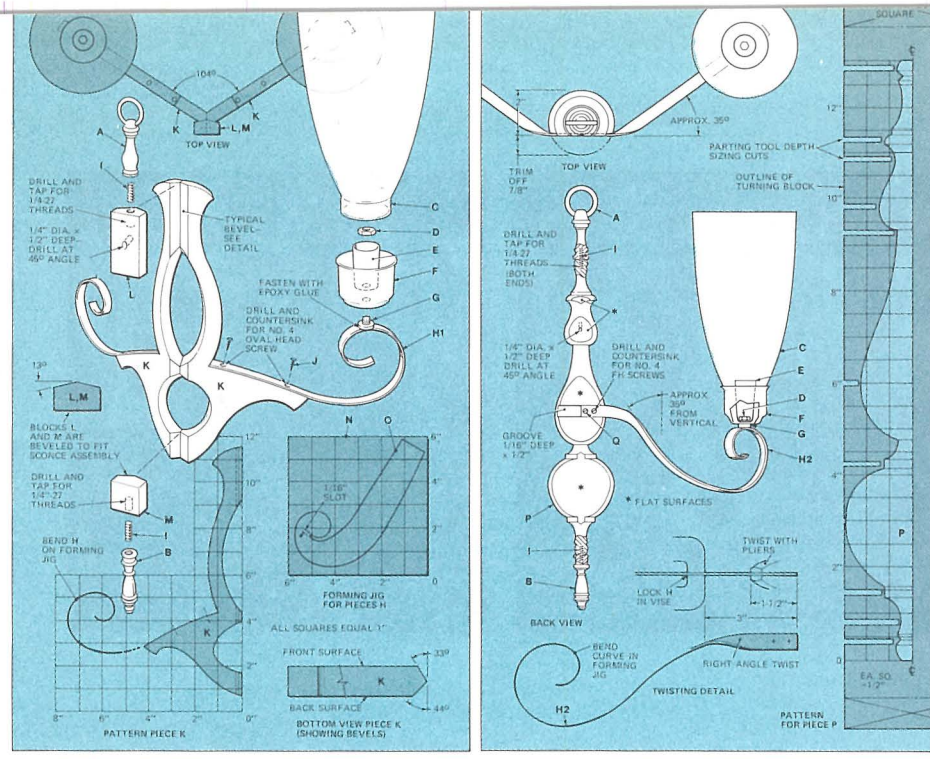
Due to the sweep of the forming block, preform a slight bend at one end of the strip to fit it into the starting slot. To do this, hold about ⅛-in. of the strip end in a vise and make a slight freehand bend. Snug the strip into the slot and bend it against the former. Keep the bottom edge of the strip flush against the backboard.

When you remove the strip, a slight amount of spring-back will occur. Resolve this by further shaping, freehand, with thumbs and index fingers. Check one arm against the other for symmetry.

Drill and countersink two holes in each arm for oval-head screws. Drill pilot holes into the wood and attach the arms temporarily. Prop the fixture vertically, then mark tops of the curls for positioning bushings.

For a good soldered joint between bushing and scroll, file a slight flat at the high point of the curvature. Then apply soldering flux to both surfaces. Hold the bushing in place with a wooden spring clip and apply the soldering-iron tip to both parts. After soldering, remove the arms from the wood and wash off flux residue at the joints.

The ornamental ring and finial have female threads that fit ⅛-in.-i.p. reducing bushings. The latter have a small inside-threaded hole for a ¼-27 bolt. You can drill and tap holes into the ends of the wood to receive bolts, but it's easier to dis-


TOP VIEW
DRILL AND TAP FOR 1/4-27 THREADS
1/4" DIA. x 1/2" DEEP DRILL AT 45° ANGLE
TYPICAL BEVEL - SEE DETAIL
FASTEN WITH EPOXY GLUE
DRILL AND COUNTERSINK FOR NO. 4 OVAL HEAD SCREW
BLOCKS L AND M ARE BEVELED TO FIT SCONCE ASSEMBLY
BEND H ON FORMING JIG
1/16" SLOT
FORMING JIG FOR PIECES H
ALL SQUARES EQUAL 1"
PATTERN PIECE K
FRONT SURFACE
BACK SURFACE
BOTTOM VIEW PIECE K (SHOWING BEVELS)
SQUARE
APPROX. 35°
PARTING TOOL DEPTH SIZING CUTS
TRIM OFF 7/8"
OUTLINE OF TURNING BLOCK
DRILL AND TAP FOR 1/4-27 THREADS (BOTH ENDS)
1/4" DIA. x 1/2" DEEP DRILL AT 45° ANGLE
DRILL AND COUNTERSINK FOR NO. 4 FH SCREWS
APPROX. 35° FROM VERTICAL
GROOVE 1/16" DEEP x 1/2"
* FLAT SURFACES
TWIST WITH PLIERS
LOCK H IN VISE
BACK VIEW
BEND CURVE IN FORMING JIG
RIGHT ANGLE TWIST
TWISTING DETAIL
PATTERN FOR PIECE P

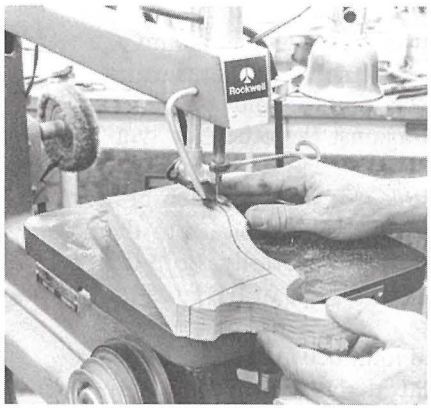
regard the bolts and attach the bushings directly to the wood with dabs of epoxy glue.

Finishing is the same for both lamps. Stain and/or top-coat the wood with a clear finish. Before final assembly, apply two light coats of spray enamel (such as Krylon No. 2202 brass) to all the metal parts. Other metallic colors such as gold, copper or silver, may be substituted.

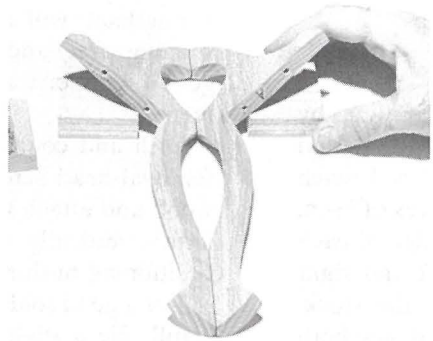
making the spindle sconce

Make a full-size pattern of the turning and draw in the parting cuts as indicated to aid in rough shaping of the spindle. Start with a square turning block. Bring the blank to rough round with the gouge, but leave a square portion at each end—you will need it to saw the back of the spindle flat later.

CUT CURVES for sconce after creating bevels on inside edges. Cut both pieces at once on bandsaw or other saw.

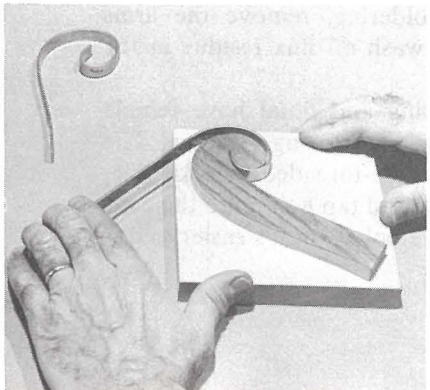


SINCE CLAMPING is not feasible on these unusual shapes, prop the pieces with scrap blocks while glue is drying.

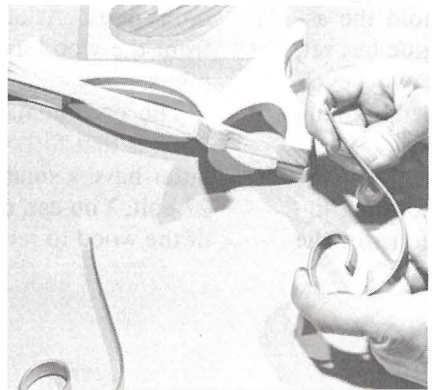


GLUE TWO face-beveled reinforcing blocks to the back. They also serve to stand the sconce off from the wall.

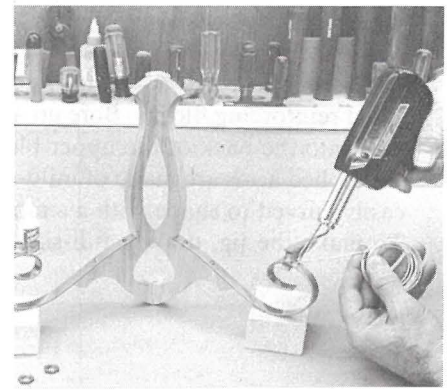
TO USE forming jig, insert bar in jig slot at curled end of bar; finish with bar against curved block.



AFTER BENDING on jig, a slight spring-back of bar will necessitate free-hand pressure to obtain final shape.



PROP FIXTURE and use clothespin to hold bushing for soldering. Always clean surfaces and apply flux.



Use the parting tool to make the sizing cuts. Set the caliper against the drawing and check constantly. When depth cuts have been made, shape the spindle by tooling from groove to groove with the spear point, skew and round-nose chisels. When the turning is ready, sand it smooth and apply sealer and paste wood filler. Then apply stain and/or top-coat finish. Do all finishing with work still on the lathe.

With the square ends supporting it, slice off the spindle flat at the back on the table saw. Cut a shallow groove into the back for flush fitting of the arms. Then cut off the waste ends. Epoxy bushings for the ring and finial to the ends.

A mild-steel bar is required to make the scrolled arm. Form the curved portion in the jig as described earlier, then secure the strip in a vise and form the 90° twist with a wrench or locking pliers. Note position of the strip in the vise and location of the pliers in the drawing, to insure that the twist occurs at the right place. Rotate the pliers 90°. Be sure to make a right- and left-hand twist, respectively, on each strip so the two will be symmetrical.

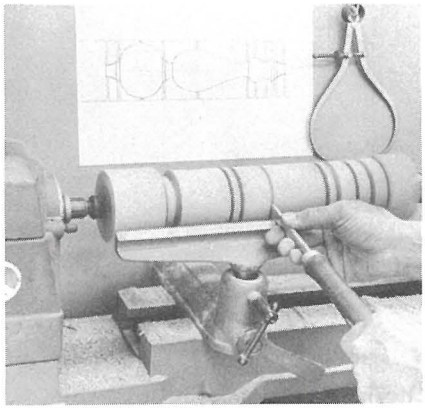
After forming the twists, place each strip horizontally into the vise, 1 in. in from each end. Grasp both strips and draw them toward you to make a bend of about 35°. Then make a downward bend, also about 35°. Check the bends with a T-bevel. Angles need not be precise, but both arms must be the same.

Use two flathead screws at the back of each arm to secure arms to the spindle. Drill an angled hole into the upper part for hanging. Solder the bushings to the arms as described earlier. Attach the candle cup and glass holder to the arm with a hex locknut. Since space doesn't permit insertion of a nut driver into the candle cup, the nut must be nursed into position with a finger. Once the nut reaches bottom, rotate the cup to tighten the nut.

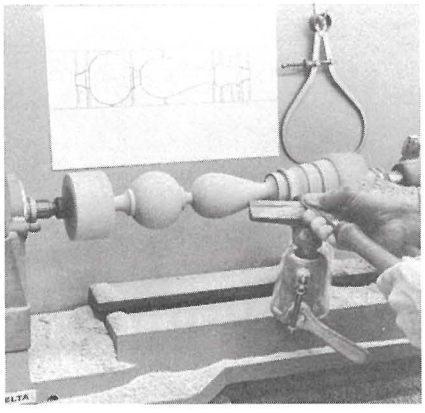
shopping for parts

The hurricane glass can be obtained at lighting-fixture supply stores, as can some, but perhaps not all, of the metal parts. A kit with all parts (except glass and candles) is available from Armor Co., Box 290, Deer Park, NY 17729. Check with Armor for the current price.

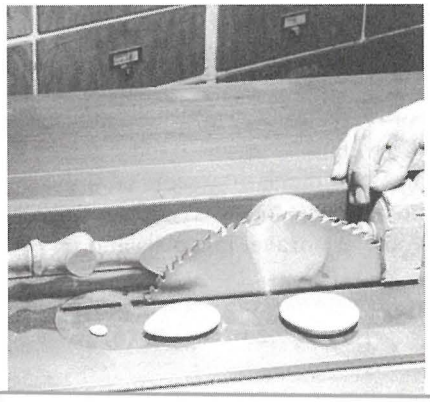
MAKE PARTING cut for various diameters on spindle turning; check against full-size drawing with calipers.



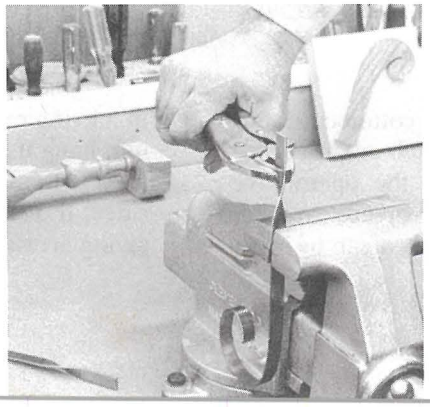
USE A GOUGE to remove a lot of stock quickly. Then proceed with the skew, round-nose and spear point to smooth.



BEFORE REMOVING the square waste at the ends of the turning, cut a flat at spindle back using the table saw.



MAKE 90° TEST bend in metal bar H2 by clamping in vise and gripping with pliers. See drawing for gripping location.

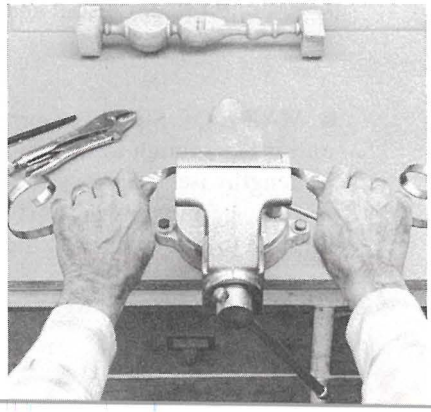


MATERIALS LIST—HURRICANE LAMPS

Key	No.	Size and description
A	1 per lamp	¼ (27) finial ring
B	1 per lamp	¼ (27) finial
C	2 per lamp	1⅝" dia. base hurricane glass
D	2 per lamp	⅛-i.p. hex locknut
E	2 per lamp	⅞" candle cup
F	2 per lamp	1⅝"-dia. glass holder
G	2 per lamp	⅛-i.p. cord inlet bushing
H1	2	1/16 × ½ × 13" mild steel*
H2	2	1/16 × ½ × 15" mild steel**
I	2 per lamp	¼ (27) ½" threaded rod
J	4	½" No. 4 oval-hd. screw*
K	1	½ × 6 × 12" oak (scrolled brackets)*
L	1	⅝ × 1 × 2¼" oak (reinforcing block)*
M	1	⅝ × 1 × 1"oak (reinforcing block)*
N	1	¾ × 6 × 6" plywood (jig)
O	1	½ × 6 × 6" hardwood, cut to shape (jig)
P	1	3 × 3 × 16" hardwood** (spindle)
Q	4	½" No. 4 fh screws**

*Required for scroll sconce only; **for spindle sconce only.

TO MAKE final freehand bends, hold the arms firmly and first bend them forward, then pull them downward.



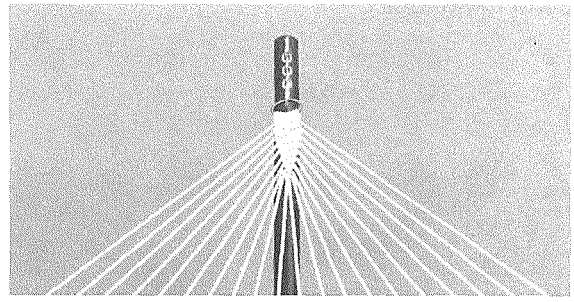
Make your own hammock

Imagine yourself swinging gently in the breeze this summer in a hammock you built yourself. Here's how to weave one from cotton rope

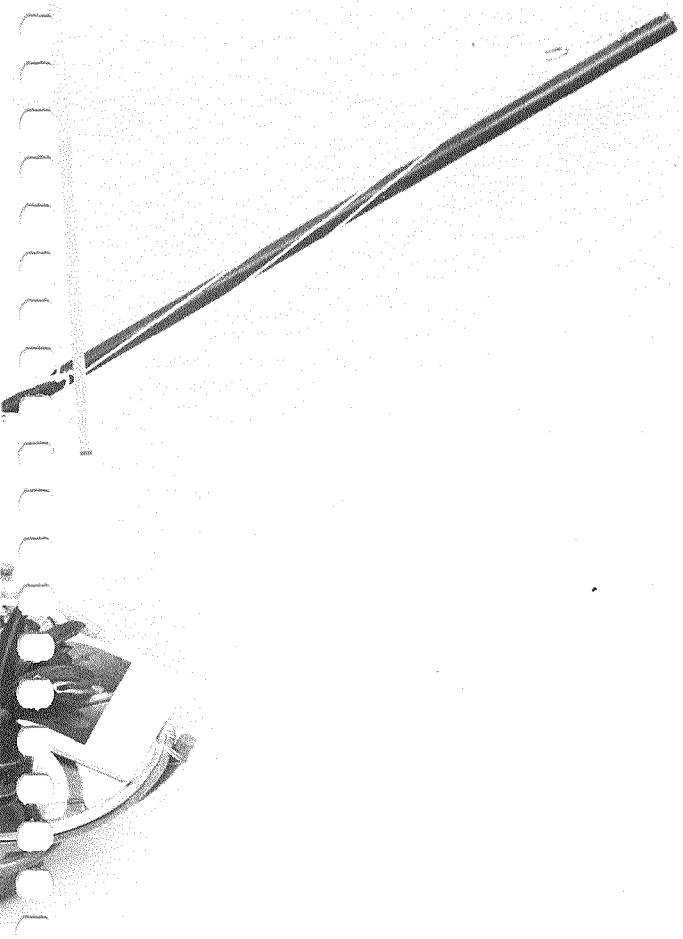
By BARBARA H. JACKSIER and JOSEPH R. PROVEY

■ MADE OF SOFT, absorbent cotton cord, our unit is big enough to let you stretch out crosswise or lengthwise. Hung outdoors, the openweave pattern permits even a slight breeze to pass through to keep you cool. Indoors, it can be hung in a living room or recreation room. When not in use, hang it on the wall.

At first, making a hammock may seem complicated. It does take patience, but weaving is a forgiving art since you can unravel mistakes and try



THIS TWENTY-STRAND harness allows the hammock to conform to the shape of your body.



again. Start off setting up the hammock loom shown on page 26.

Make two braids to form the hammock edges next. For each braid, cut two 220-in. lengths. Tie one pair at their middles to a loom pole using a square knot. Begin to braid by placing the rightmost strand over the one to its left. Then place the leftmost strand over the two strands to the right. Repeat these two steps, always working the right cord over one cord to the left and the left cord over two cords to the right, until the braid is 80-in. long, including the starting loop. Now, tie the loose end of the braid to the other dowel with a square knot. Insert 16 paper clips at the ends of the braid and at 4-in. intervals. Slip it down the poles to make room for a second braid and for weaving of the body of your hammock.

When both braids have been completed, make a plywood shuttle as shown on page 26 and wind about a third of your cord onto it. Unwind about 9 ft. and bind the cut end. Then, starting at the right-hand edge of the top braid, thread the bound end from front to back through the braid at the first paper clip. Repeat this at each clip. Tie the bound end of the cord to the left dowel under the top braid when finished.

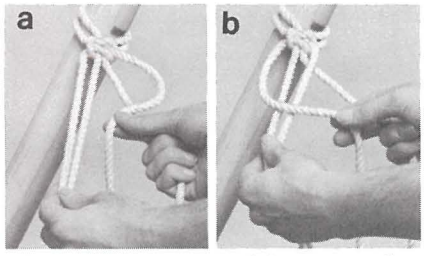
At the right dowel, pull the cord back through the braid until it's taut. Stretch the cord to the pole top and hold it there while extending the cord down to the X-mark. *This point marks the total length (89 in.) of the first and all subsequent rows of cord.* To register this point, wind it around the nail at the top of the pole and prepare to weave next row by dispersing slack equally to form loops.

All of the following rows are woven using the shuttle. Bring it around the outside of the loom pole and toward you, passing under the top braid. Then push it from front to back through the first loop and each remaining loop, making 15 passes in all. Pull the cord taut and once again register an 89-in. length using the X-mark. Wind it around the nail atop the second loom pole. Redisperse the slack and the second row is complete. Pass the shuttle around the dowel as before.

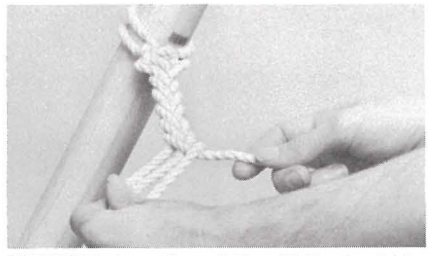
The first loop in the third row is formed by passing the shuttle from back to front through the leftmost loop. The end loops are easy to miss. *Be sure you make 15 passes per row.* Complete the third row, register the 89-in. length, and wind it around the nail on the loom pole after letting the first row's cord slip down over the dowel. Pass the shuttle around the dowel and repeat the instructions for weaving the second and third rows until you have 37 loops on each dowel, not including the braid loops.

To help locate loops through which you'll be

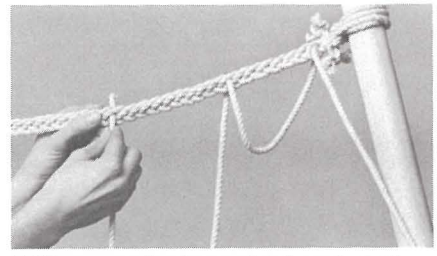
Weaving the hammock



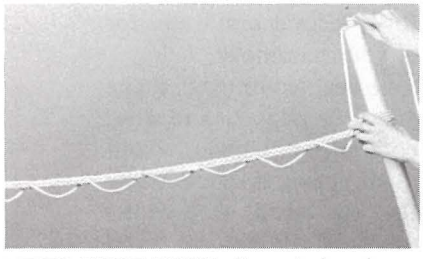
TO MAKE braid, place rightmost cord over cord to left (A). Then place leftmost cord over two cords to right (B).



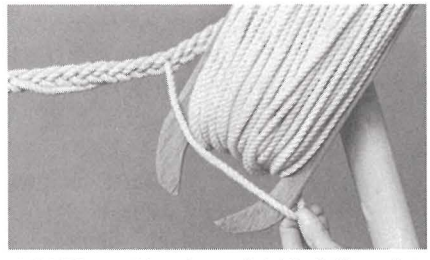
REPEAT steps A and B until the braid is complete. Pull the strands tight to assure a strong braid.



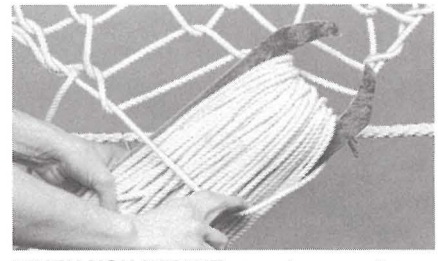
USE paper clips to mark intervals and thread first row of mesh into braid. Pointed dowel opens braid for threading.



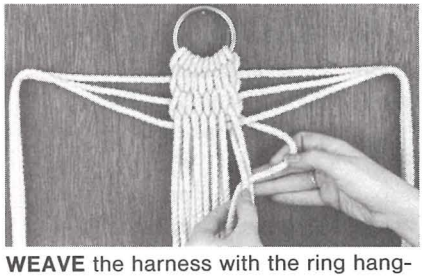
AFTER FIRST ROW is threaded and tied to left loom pole, measure length using X-mark and disperse slack to form loops.



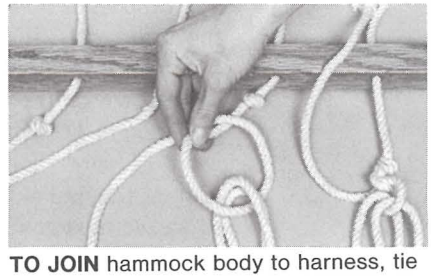
AGAIN, working from right to left, make the second row by passing the shuttle, front to back, through the loops.



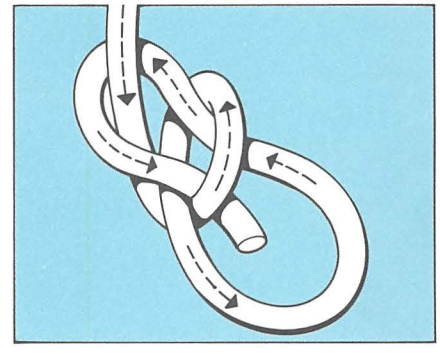
WHEN YOU WEAVE rows in opposite directions (from left to right), pass shuttle and cord back to front through loops.

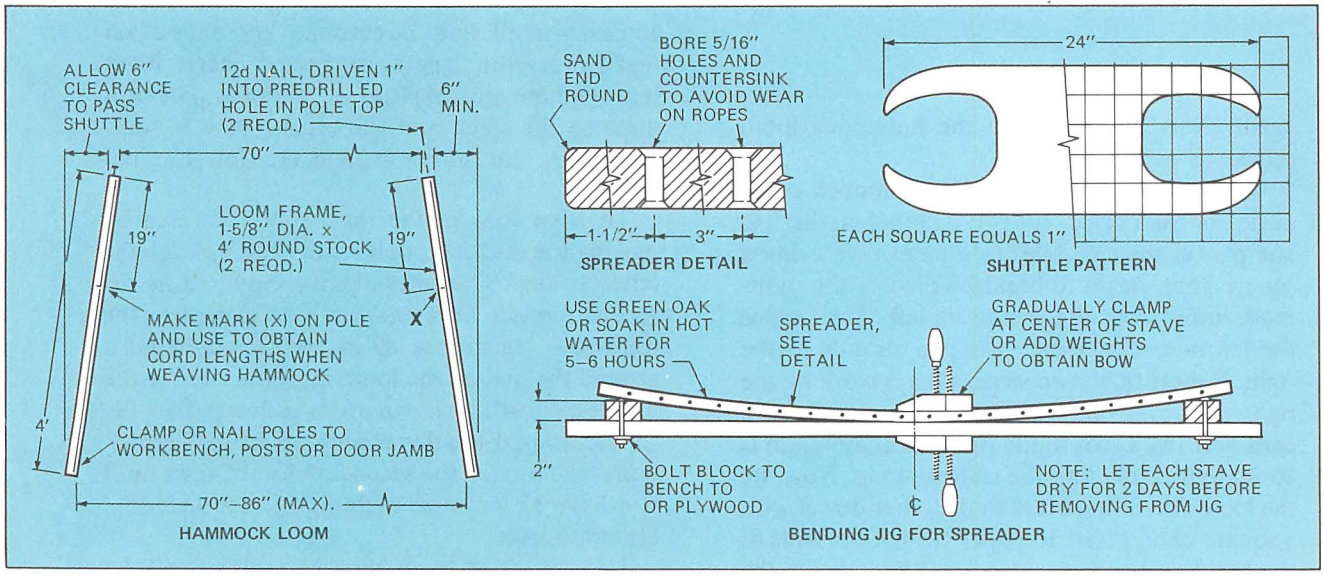


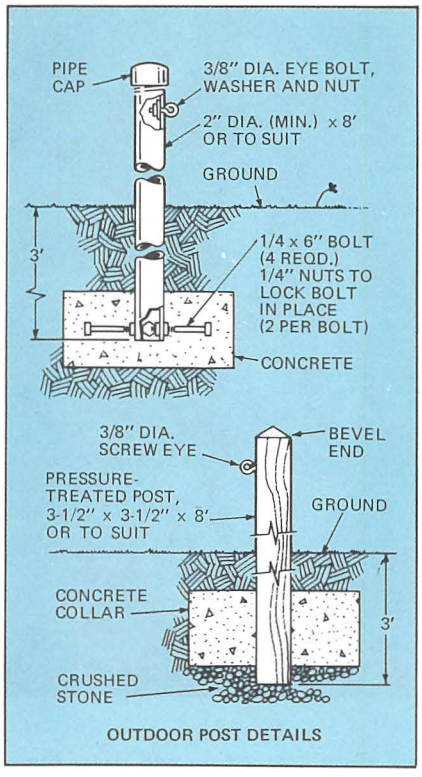
WEAVE the harness with the ring hanging on wall. Use a pair of nails to permit hanging woven strands out of the way.

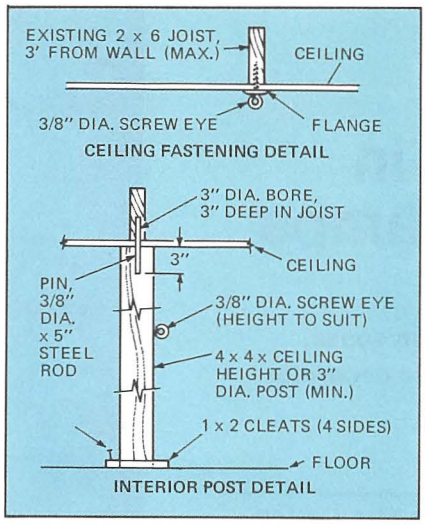


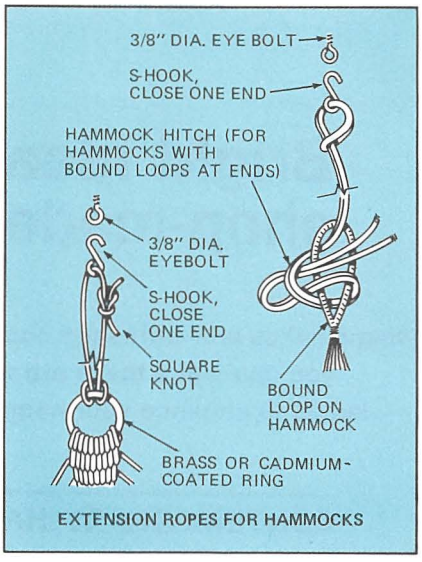
TO JOIN hammock body to harness, tie loops of mesh, two at a time, to corresponding harness cords using a bowline (right).




ALLOW 6" CLEARANCE TO PASS SHUTTLE
12d NAIL, DRIVEN 1" INTO PREDRILLED HOLE IN POLE TOP (2 REQD.)
6" MIN.
70"
19"
LOOM FRAME, 1-5/8" DIA. x 4' ROUND STOCK (2 REQD.)
19"
MAKE MARK (X) ON POLE AND USE TO OBTAIN CORD LENGTHS WHEN WEAVING HAMMOCK
X
4'
CLAMP OR NAIL POLES TO WORKBENCH, POSTS OR DOOR JAMB
70"–86" (MAX).
HAMMOCK LOOM
SAND END ROUND
BORE 5/16" HOLES AND COUNTERSINK TO AVOID WEAR ON ROPES
1-1/2"
3"
SPREADER DETAIL
24"
EACH SQUARE EQUALS 1"
SHUTTLE PATTERN
USE GREEN OAK OR SOAK IN HOT WATER FOR 5–6 HOURS
SPREADER, SEE DETAIL
GRADUALLY CLAMP AT CENTER OF STAVE OR ADD WEIGHTS TO OBTAIN BOW
2"
BOLT BLOCK TO BENCH TO OR PLYWOOD
NOTE: LET EACH STAVE DRY FOR 2 DAYS BEFORE REMOVING FROM JIG
BENDING JIG FOR SPREADER


PIPE CAP
3/8" DIA. EYE BOLT, WASHER AND NUT
2" DIA. (MIN.) x 8' OR TO SUIT
GROUND
3'
1/4 x 6" BOLT (4 REQD.) 1/4" NUTS TO LOCK BOLT IN PLACE (2 PER BOLT)
CONCRETE
3/8" DIA. SCREW EYE
BEVEL END
PRESSURE-TREATED POST, 3-1/2" x 3-1/2" x 8' OR TO SUIT
GROUND
CONCRETE COLLAR
3'
CRUSHED STONE
OUTDOOR POST DETAILS


EXISTING 2 x 6 JOIST, 3' FROM WALL (MAX.)
CEILING
3/8" DIA. SCREW EYE
FLANGE
CEILING FASTENING DETAIL
3" DIA. BORE, 3" DEEP IN JOIST
3"
CEILING
PIN, 3/8" DIA. x 5" STEEL ROD
3/8" DIA. SCREW EYE (HEIGHT TO SUIT)
4 x 4 x CEILING HEIGHT OR 3" DIA. POST (MIN.)
1 x 2 CLEATS (4 SIDES)
FLOOR
INTERIOR POST DETAIL


3/8" DIA. EYE BOLT
S-HOOK, CLOSE ONE END
HAMMOCK HITCH (FOR HAMMOCKS WITH BOUND LOOPS AT ENDS)
3/8" DIA. EYEBOLT
S-HOOK, CLOSE ONE END
SQUARE KNOT
BOUND LOOP ON HAMMOCK
BRASS OR CADMIUM-COATED RING
EXTENSION ROPES FOR HAMMOCKS

MATERIALS LIST—HAMMOCK

No.	Size and description (use)
1	¼" dia. x 1000' cotton cord (hammock body, edging and harnesses)
2	1 x 1 x 60" oak (spreaders); rip and resaw from 5/4" stock
2	2" dia. rings, brass or cadmium-coated (harness rings)
2	1⅝" dia. x 4' round stock (loom frame)
1	¼ x 5 x 24" plywood (shuttle)

Misc. White adhesive tape or string for binding cord ends; 5 10d common nails; 32 large paper clips

Note: Hammock stand shown on page 24 is from Hammacher Schlemmer, 145 E. 57th St., New York, NY 10022

weaving, go back to the loom pole around which you most recently turned and pull up on the cord attached to the nail. This will put tension on the last row worked and make it easier to spot.

When the shuttle runs out of cord, rewind it with a new supply. Tie the old and new together with a square knot at *one of the loom poles* so the knot won't end up in the middle of the hammock body.

When there are 37 rows, leave 9 ft. and cut the cord. Bind the end and thread it through the first braid you made at the first paper clip, and then through the first loop in the 37th row. Continue to alternate until the edging is joined to the hammock body. Then tie the cord end to the loom pole.

Before removing the hammock body from the loom, pass a cord through all the end loops on each pole. Tie the ends of each cord together and remove the hammock body from the loom.

To make each harness, cut 10 130-in. lengths and pass them halfway through a ring. Hang the ring on the wall between two flanking nails, as shown in photo on page 26, and arrange the strands in order with a distinct front and back row. Bring the rightmost strand on the back row over the rightmost strand on the front row. Then weave it under the next strand on the back row. Continue across in this manner and place the strand over the left nail when done.

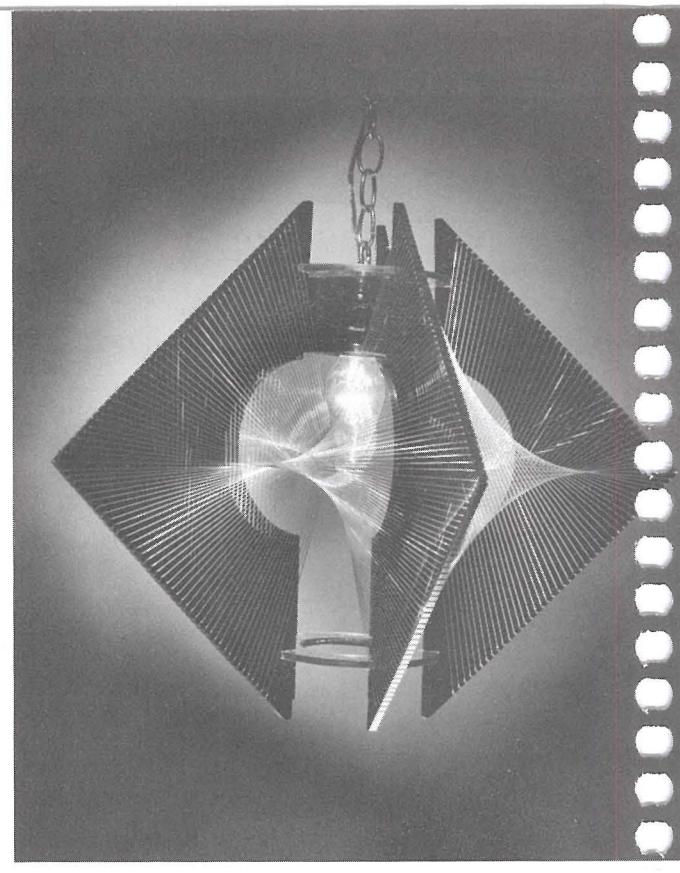
Now take the leftmost strand and bring it under all front strands. Place it over the right side nail. Repeat for each strand until two remain. Make a square knot.

Pass the 20 strands of each harness through the 20 holes in each spreader. Make overhand knots. Then hang the harnesses and adjust knots to equal tension on all cords. Repeat for the other harness.

Finally, group end loops of the hammock (count braid ends as one loop) in pairs and tie one harness strand to each group using a bowline knot. Trim and bind all the ends to prevent unraveling.

Bright ideas in shop-made lamps

Using plastics and workshop common sense, you can make these attractive decorator lamps to enhance your home



CONTEMPORARY HANGING LAMP

By JOHN GAYNOR

■ ANYONE WHO has recently visited a lamp store knows that this hanging lamp would cost many times the $15 it costs to make it yourself. Although the project requires some patience, it's easy to create.

First, get some smoked plexiglass. It's available at most plastic dealers—where you may be able to buy scrap pieces. Be sure the scraps are all the same color and still have protective paper on.

Cut pieces to size, with table saw and a plywood blade or sabre saw and a fine-tooth blade. Use a circle cutter and drill press to make the circular cutouts. To make the cuts, clamp workpiece to the table and, at slowest speed, cut halfway through the plastic. Then stop the press, turn the plexiglass over, re-clamp and finish the cut.

Using a bandsaw, cut the three squares into six triangles. To sand edges even, first glue the triangles with rubber cement, matching edges as closely as possible. Also glue discs B and C together. Use an electric sander with a rough grade of paper to even the edges. Then use a scraper to smooth all exposed plastic edges. Buff edges with double O steel wool until they begin to shine. Continue buffing until shiny with an electric buffer or plastic polish (rouge) and a rag.

With triangles and discs still glued, cut all notches with the bandsaw. Carefully cut notches for a snug fit.

Carefully pry apart triangles and discs with a putty knife. Then remove protective paper covering. Redrill the center hole in B and buff the inside edge of the other circle.

Assemble with rubber bands and solvent glue at joints. A syringe is best for applying the solvent at the joints. Capillary action will draw the solvent into the joint surfaces. Be careful not to spill glue on the plexiglass, as it leaves a permanent blemish.

At this point you may want to make a plexiglass cube to hide the light socket. Use the spare triangle to cut pieces (D).

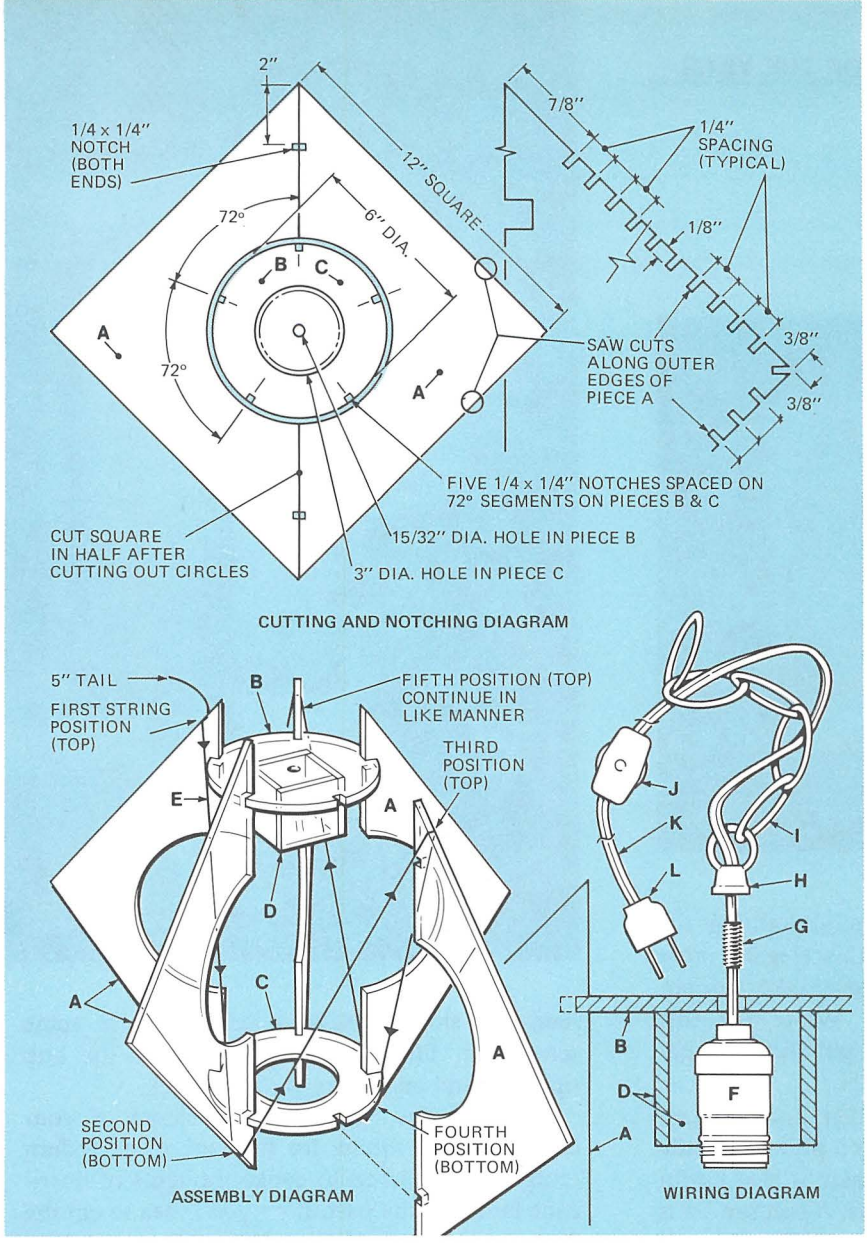
Clean surfaces thoroughly with an alcohol-soaked rag. Then tie a knot in one end of the fishing line so it catches in a side slot. Leave a 5-in. long tail. Beginning at an end slot in one side, thread the lamp. End at the middle slot on one side. Tie another knot in the fishing line to catch in the last slot and snip, leaving a 5-in. tail. Tie tails together.

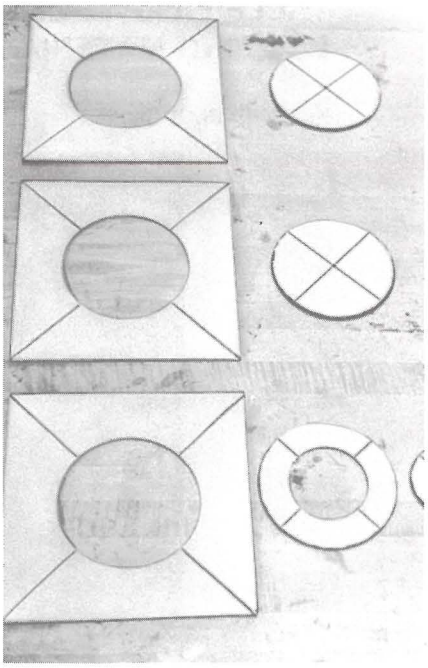
Install electrical parts and hang the lamp with a toggle bolt and decorative hook. *Caution:* Use a 60-watt (or less) bulb to avoid heat damage.

MATERIALS LIST—HANGING LAMP

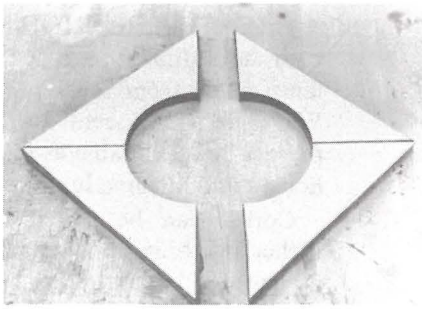
Key	No.	Size and description
A	5	¼" smoked plexiglass (see cutting diagram)
B	1	¼" smoked plexiglass (see cutting diagram)
C	1	¼" smoked plexiglass (see cutting diagram)
D	4	¼ × 2½ × 2¾" smoked plexiglass
E	as reqd.	25 to 40-lb. monofilament fishing line
F	1	light socket
G	1	⅜"-dia. threaded pipe
H	1	⅜" female nipple
I	1	10 to 12-ft. link chain
J	1	line cord switch
K	1	12 to 15-ft. No. 18 lamp cord
L	1	plug

Misc.: Toggle bolt and decorative hook, 25 to 40-watt bulb, cyanoacrylate-type glue.



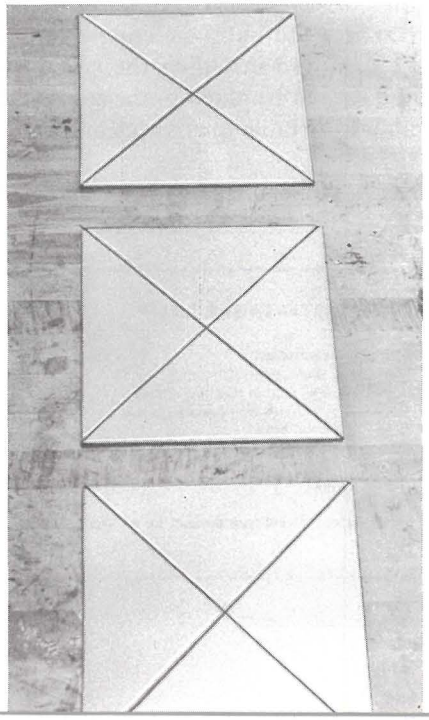


4 **SMALL DISC,** one large disc and one triangular half-square are spare.

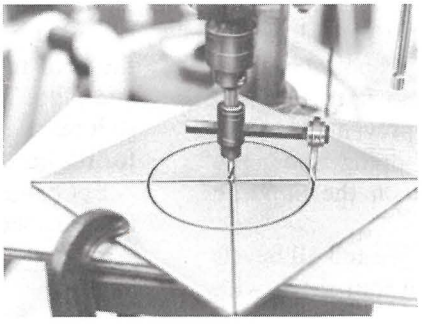


5 **SAW SQUARES** along a diagonal; temporarily glue them.

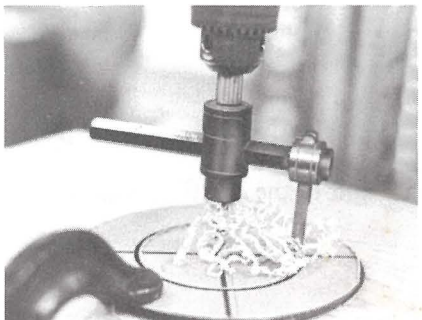
1 **THREE SQUARES** of plexiglass are required for lamp,



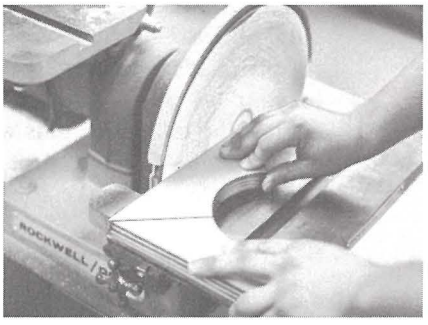
2 **CLAMP SQUARE** securely to work surface, use circle cutter,



3 **CUT A SECOND,** 3-in.-dia. circle, but in only one of the big discs.



6 **TO EVEN** straight edges, use stationary sander with coarse abrasive.



7 **USE BANDSAW** to cut notches for fish line. (See notching diagram above.)

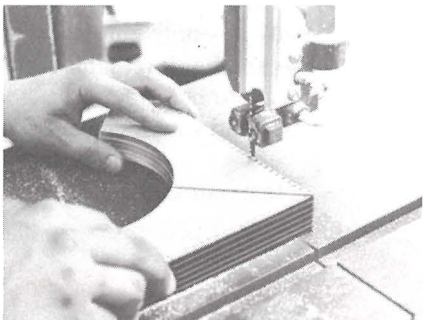
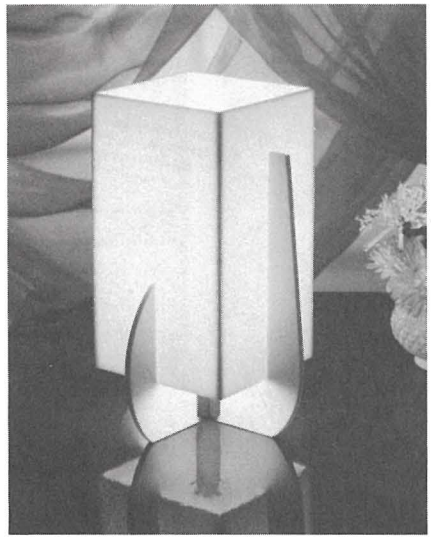
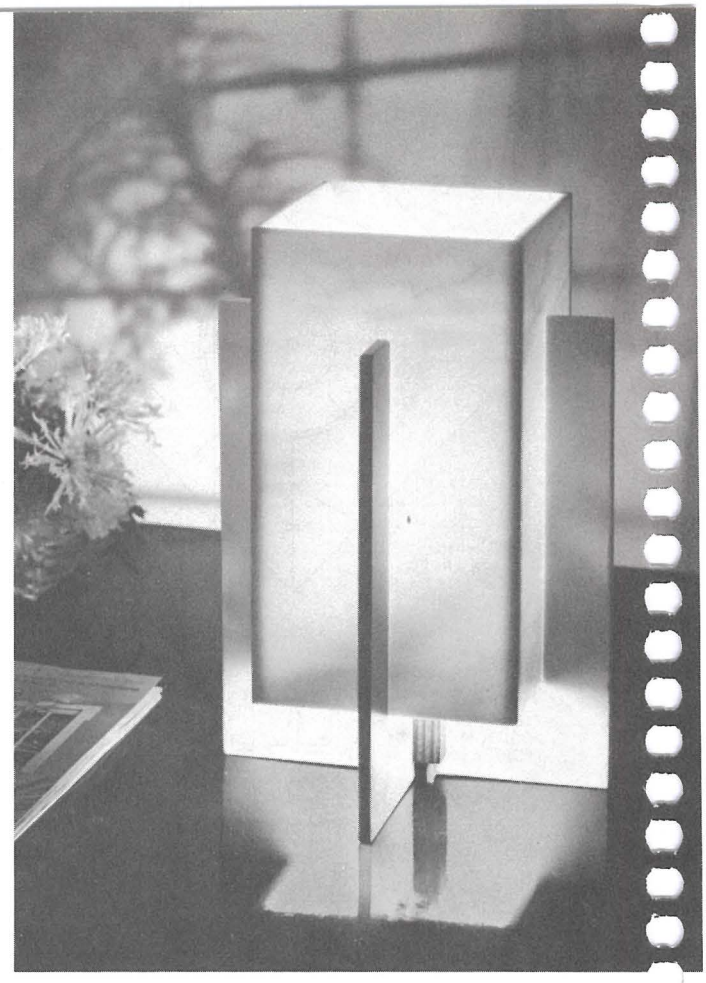


TABLE LAMP FROM BUILDING MATERIAL

By DAVID BLODGETT





■ CREATE THE RIGHT mood lighting for your next dinner party with this elegant table lamp made from Dupont's marble-like Corian. We used translucent Cameo White for this project—it's available at many plumbing supply houses and at some lumberyards.

Corian can be sawed, drilled and sanded. Either a carbide-tipped blade or a plywood blade is required for cutting. A hacksaw is also useful for completing inside corner cuts. A belt sander is best for dressing the edges. For bonding the material use any one of the new cyanoacrylate adhesives.

To build the lamp, start by making the rectangular shade. Cut the four panels (B) as shown in the plans. It's necessary to clamp a board parallel to your table saw's rip fence so it rests firmly against the table top. This will prevent the sharp edge of the 45° bevel from slipping under the fence while you make the cut on the opposite edge.

After cutting the panels, lightly sand all bevels with fine sandpaper. Line up all four sides (with the bevels down), and tape the edges together for easy assembly. Fold the four hinged panels into the rectangular shade shape and check for fit. If it's okay, apply glue and form the rectangle, taking care that it remains square. Use rubber bands or tape to hold the pieces together while the glue sets. Sand rough edges and excess glue with fine paper.

Next, cut and bore the wooden hub to the dimensions shown. Make a test groove in some scrap first. The spoke legs should fit the hub tightly. Sand and spray the hub black.

Now cut the spokes to the shape of your choice—either square for the look of a modern sculpture, or curved to evoke thoughts of hurricane lamps of the past. It's a good idea to cut the feet on the spokes slightly long. After a trial assembly, use the belt sander to shorten them so the spokes fit snugly.

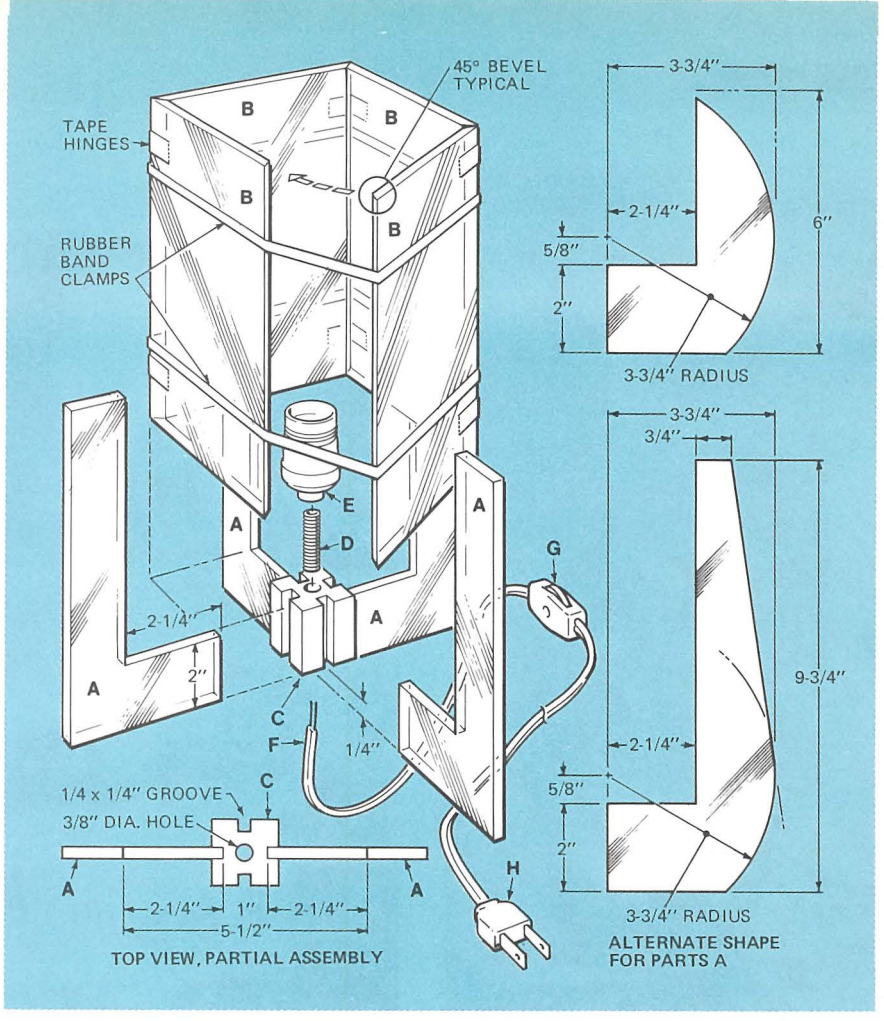
Make the final assembly by forcing the threaded pipe (D) into the hub (C), connecting the cord to the socket and installing the switch and plug. The hub should be glued to the spokes so it rests ¼ in. above the table to allow clearance for the cord.

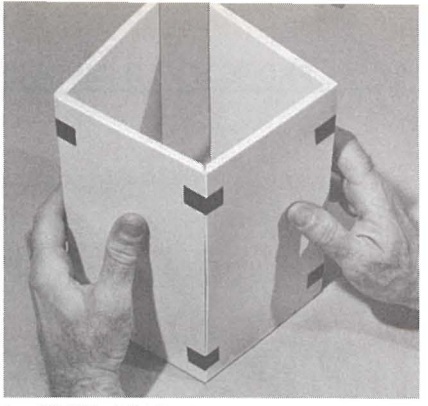
For extra strength, you should bond the shade to the spokes with a few drops of adhesive.

MATERIALS LIST—TABLE LAMP

Key	No.	Size and description
A	4	¼ × 3⅞ × 9¾" Corian (Cameo White)
B	4	¼ × 5½ × 9¾" Corian (Cameo White)
C	1	1½ × 1½ × 2" hardwood (painted black)
D	1	⅜"-dia. threaded pipe
E	1	light socket
F	1	12 to 15-ft. No. 18 lamp cord
G	1	line cord switch
H	1	plug

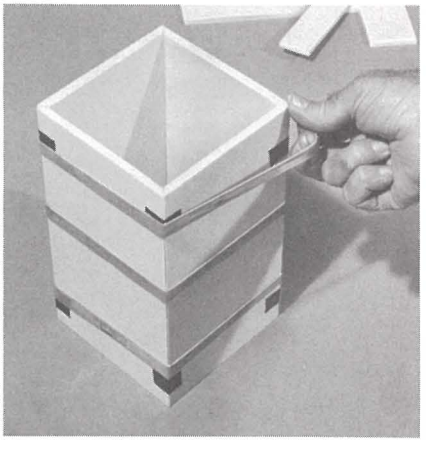
Misc.: Rubber bands, tape, solvent-type cement for acrylic plastic.

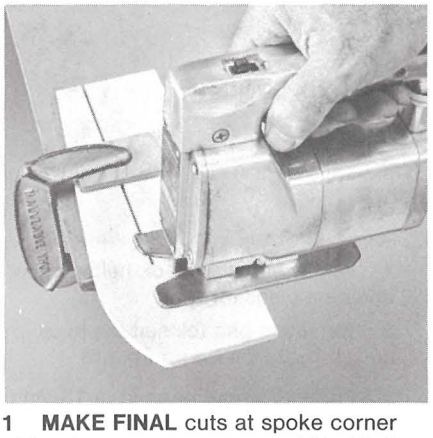




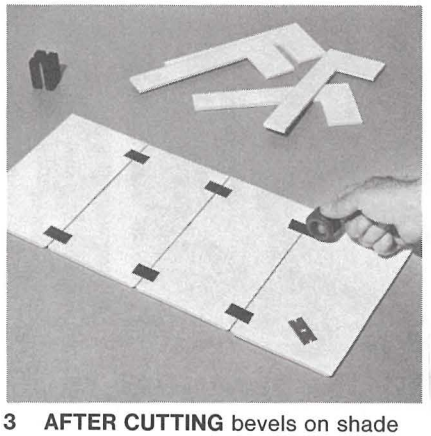
5 NEXT, FOLD side panels (B) to form shade. Tape pieces are temporary.

6 CHECK SHADE for square and use rubber bands as clamps.

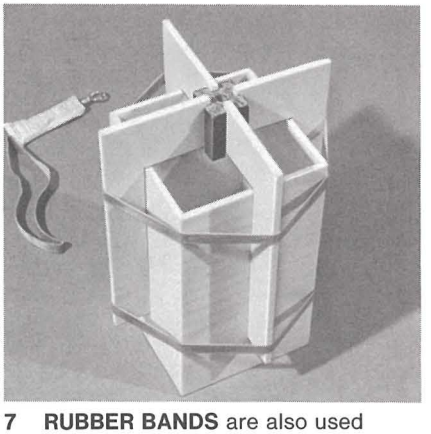




1 MAKE FINAL cuts at spoke corner with sabre saw, tungsten-carbide blade.



3 AFTER CUTTING bevels on shade panels, apply tape to facilitate gluing.

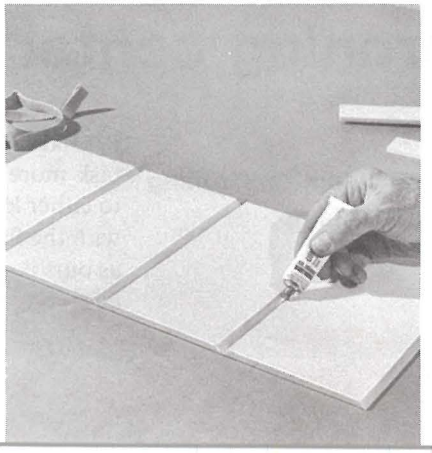


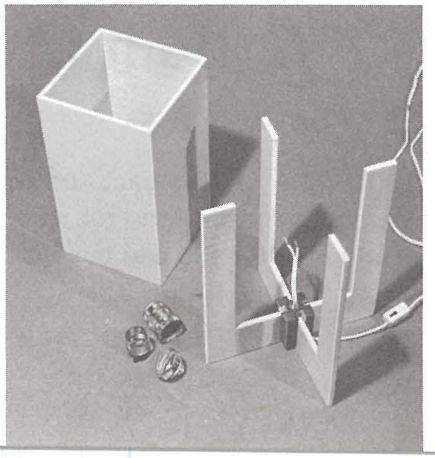
7 RUBBER BANDS are also used while joining spokes (A) to hub (C).

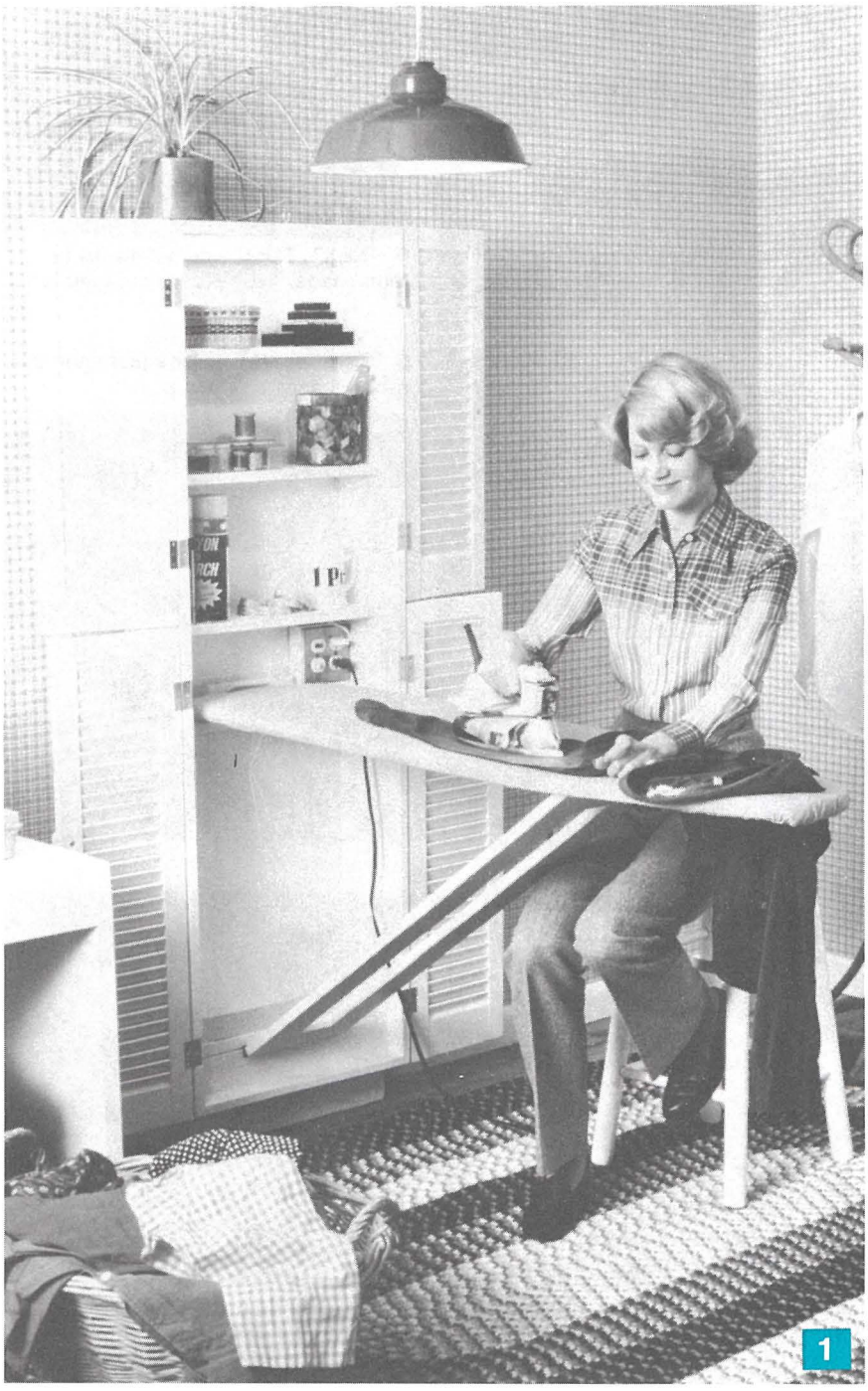
2 CLAMP WOOD strip to fence to stop beveled edge from slipping below.

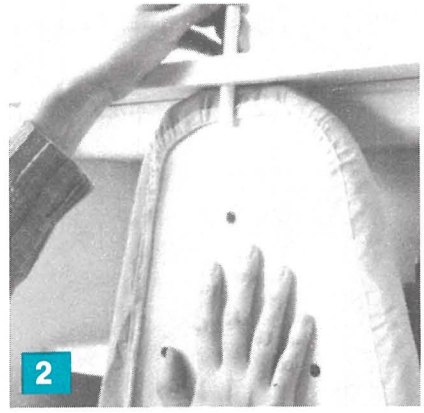
4 APPLY GLUE along each beveled edge; cyanoacrylate works best.

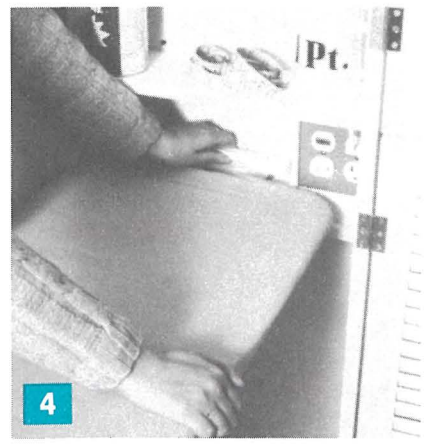
8 BEFORE CONNECTING cord to socket, pass leads through nipple (D).











1 Unit with built-in look helps make ironing a pleasant task.

2 Retaining peg (closed cuphook and dowel) holds the board upright.

3 For light where needed, a 15-watt fluorescent lamp fits perfectly.

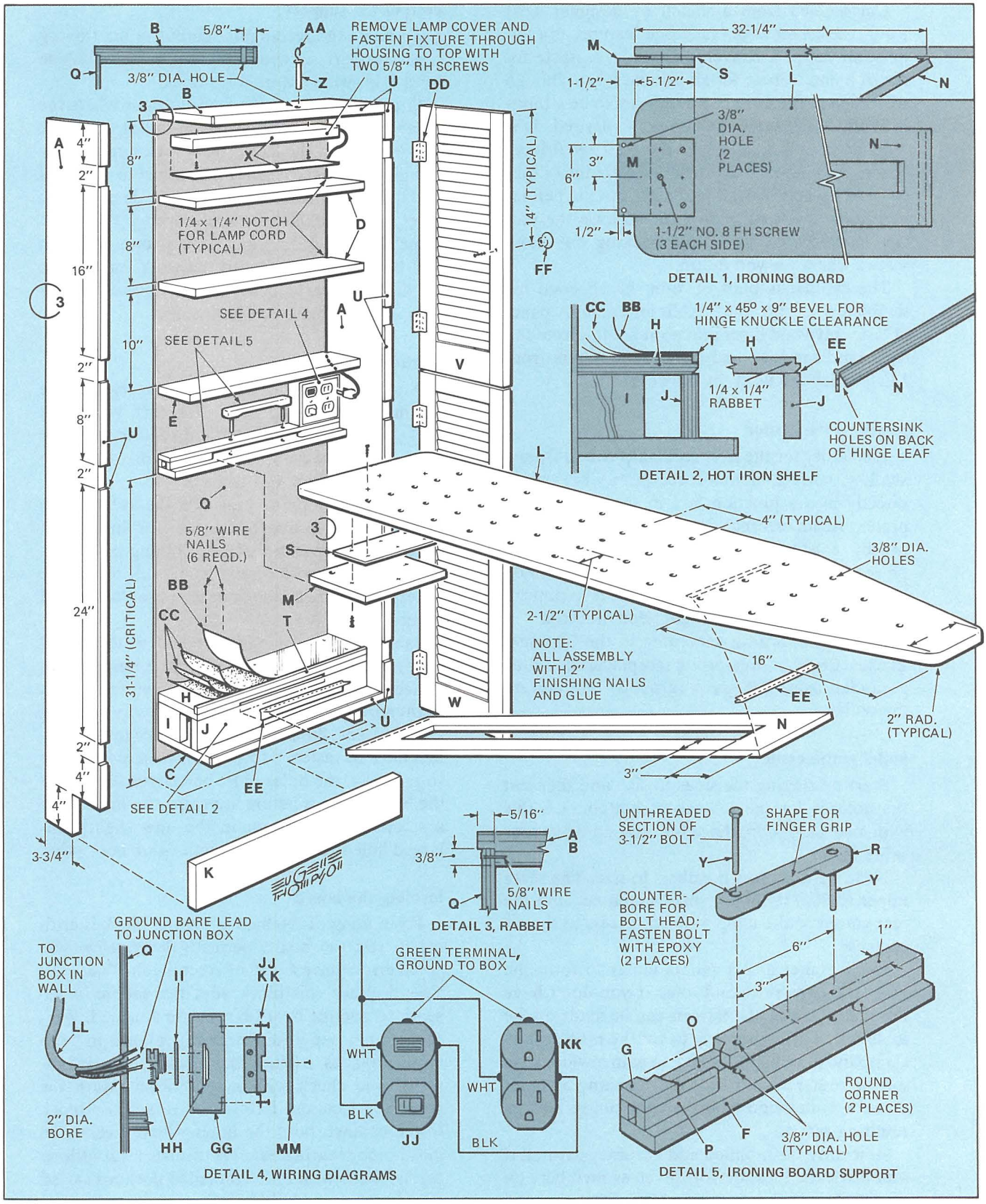
4 Shop-made support (detail 5 in drawing) holds the board level.

A 'built-in' ironing center

By HARRY WICKS

Compact and smart-looking, this ironing center includes wiring for an iron and a lamp. Here's how you can build it

■ ONE SURE WAY to make the weekly ironing task more pleasant is to move the ironing center to either kitchen or family room so its user can be with the family. If you make the center attractive, as ours is, the piece of furniture will be a welcome addition.


REMOVE LAMP COVER AND FASTEN FIXTURE THROUGH HOUSING TO TOP WITH TWO 5/8" RH SCREWS
3/8" DIA. HOLE
5/8"
1/4 x 1/4" NOTCH FOR LAMP CORD (TYPICAL)
SEE DETAIL 4
SEE DETAIL 5
SEE DETAIL 2
5/8" WIRE NAILS (6 REQD.)
31-1/4" (CRITICAL)
14" (TYPICAL)
4" (TYPICAL)
3/8" DIA. HOLES
2-1/2" (TYPICAL)
16"
2" RAD. (TYPICAL)
NOTE: ALL ASSEMBLY WITH 2" FINISHING NAILS AND GLUE
3-3/4"
DETAIL 1, IRONING BOARD
32-1/4"
1-1/2"
5-1/2"
3/8" DIA. HOLE (2 PLACES)
1-1/2" NO. 8 FH SCREW (3 EACH SIDE)
DETAIL 2, HOT IRON SHELF
1/4" x 45° x 9" BEVEL FOR HINGE KNUCKLE CLEARANCE
1/4 x 1/4" RABBET
COUNTERSINK HOLES ON BACK OF HINGE LEAF
DETAIL 3, RABBET
5/16"
3/8"
5/8" WIRE NAILS
DETAIL 4, WIRING DIAGRAMS
GROUND BARE LEAD TO JUNCTION BOX
TO JUNCTION BOX IN WALL
2" DIA. BORE
GREEN TERMINAL, GROUND TO BOX
WHT
BLK
DETAIL 5, IRONING BOARD SUPPORT
UNTHREADED SECTION OF 3-1/2" BOLT
SHAPE FOR FINGER GRIP
COUNTER-BORE FOR BOLT HEAD; FASTEN BOLT WITH EPOXY (2 PLACES)
ROUND CORNER (2 PLACES)
3/8" DIA. HOLE (TYPICAL)

Constructed from a sketch by designer Tom Fung, the center offers such fine features as a fluorescent lamp, a convenient wall receptacle for the iron and storage for all ironing tools. Though we designed the center so it appears to be a built-in, ours can actually be moved if desired. It is "permanently" attached to the wall by driving screws through its back panel directly into studs, or by using hollow-wall fasteners. But the permanent look is not so permanent because the unit can be relocated by simply backing out those screws whenever you desire.

The cabinet is built of ¾-in. fir plywood assembled with butt joints, nails and glue. A panel of ¼-in. plywood is set into a rabbet to create the back, and sanded, ready-to-finish shutters from J.C. Penney are used for the doors.

power to the center

Electricity for the iron and lamp comes from a shallow, surface-mounted receptable box wired directly into a junction box in the wall. If you prefer, use an external line to plug directly into a nearby existing outlet. So you'll know when power is on or off, we have included a handy combination switch/pilot light. This is to prevent accidents caused by an unattended, hot iron.

Install your wiring according to the National Electric Code; a three-prong receptacle should be grounded using the green (ground) terminal on the outlet.

building the center

Start by ripping the sides to size and then cut the notches for the setback at bottom. Do this with two passes on the table saw or with your sabre saw.

Next, cut the cross members to size. The three upper shelves require a small notch cut into the rear corner so the lamp wire has access to the receptacle.

Use a router and a rabbet cutter to form the rabbets on the sides and tops. If you don't have this versatile tool, the rabbets can be made on the table saw. The easiest way to cut the rabbets is to clamp the sides back-to-back to gain a wider base for the router shoe to ride on. Running a router down a ¾-in.-wide board invites tilting and its resulting errors.

Assembly is simplified and accuracy assured if you mark the location for the cross members on the insides of the side members. Start the nail points at each butt joint (before applying glue) to check for alignment. Use 2-in. finishing nails for assembly. Set and fill the holes later.

cutting the support

To make the rectangular cutout in the ironing board support, set your table saw fence and blade for a 3-in.-wide cut in ¾-in. stock.

Stick some tape on the fence to show where the blade enters the work (from below) at the back, and leaves it at the front. Lower the blade below the table surface. Position the panel as required and turn it on the saw. Crank the blade up until it emerges from the work, and advance the workpiece. The taped markers (see photo, page 35) will be helpful in aligning the work for the cut. To drop out waste, complete the cuts at the corners with a sabre or crosscut saw.

the ironing board

After cutting the ironing board to shape, bore the moisture-venting holes. Whether you use a drill press or portable electric drill to make these holes, you must clamp a backup board in place to prevent splintering on the back side.

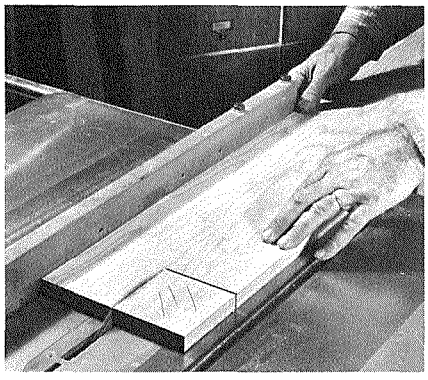
The hinge support block at the rear of the ironing board is attached to a ½-in. hardboard (or plywood) spacer. For best holding power, secure the board with screws from both sides. The spacer assures neat attachment of the cloth board covers.

Sand the support and attach it to the board with a strip hinge cut to length. The hinge which attaches the support to the cabinet requires a slight modification. Due to the necessary pivoting arrangement, the leaf which attaches to the cabinet must be fastened through its back side. To do so properly, the holes must be countersunk from the back. Do this before attaching the hinge. Use a screw one size larger in the now slightly-enlarged hole that has been countersunk both sides.

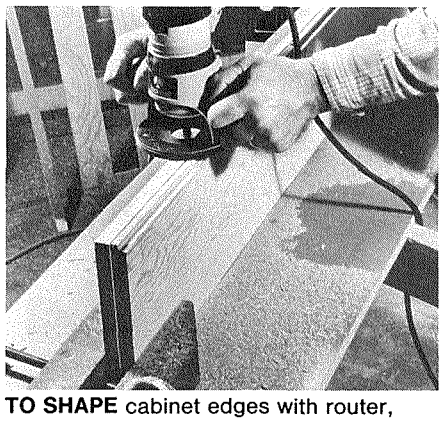
leveling the board

Positioning of the board-holding block is critical to rest the board perfectly level. However, small errors have a way of creeping in. Thus, you should attach this block after the cabinet is assembled and the board hinges are attached. With the cabinet supported perfectly plumb in both vertical planes, position the block with board inserted and check with a spirit level. Mark the mounting location. Before you attach the block to the cabinet, bore the holes which receive the pins of the securing bar. The securing bar utilizes two lag bolts with lower threaded portions sawed off. Use epoxy to hold bolts.

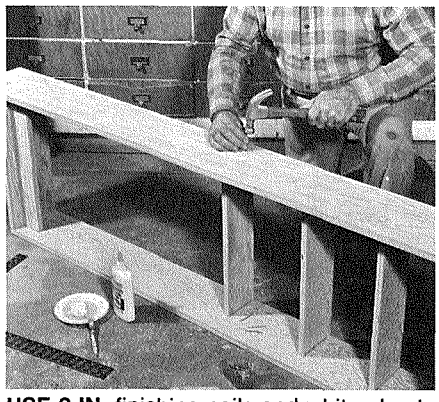
A novel way to "mortise" the hinges into the cabinet is to build up beyond the hinges with ⅛-in. strips of clear pine. This simplifies the job and



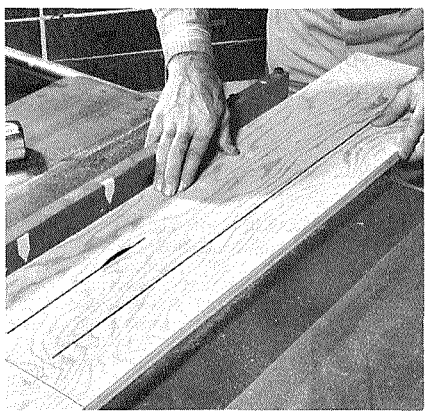
WHEN MAKING a partial cut on the table saw (to drop out a corner), make certain the cutoff is on the free side of the blade to prevent a possible jam.



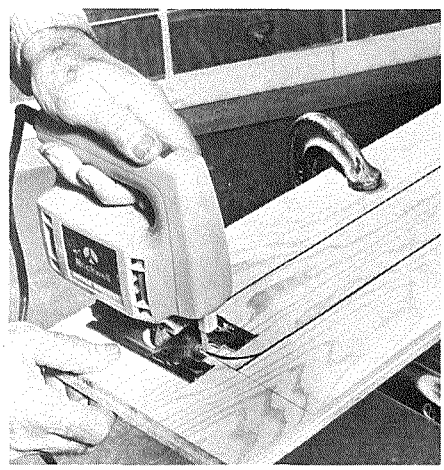
TO SHAPE cabinet edges with router, clamp sides together so that the router has a wider surface to ride on.



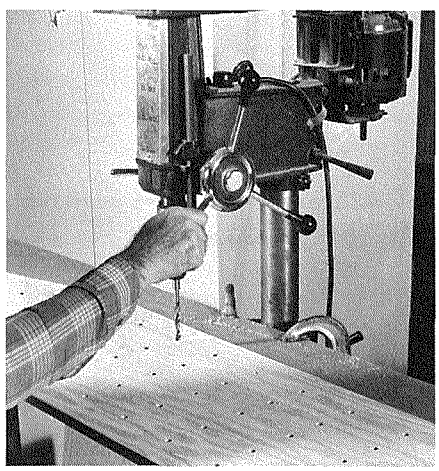
USE 2-IN. finishing nails and white glue to assemble; check with a framing square for trueness repeatedly. Use diagonal strips to adjust the box.



TO MAKE partially through cuts, blade is slowly elevated into the work. Tapes on rip fence show where cut begins and ends on the bottom surface.

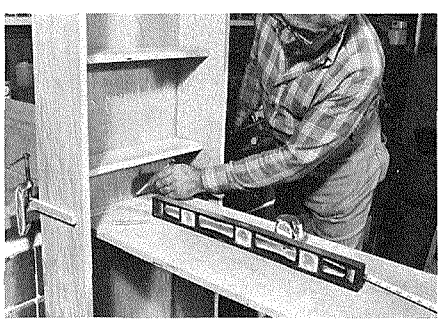


USE THE sabre saw or, if by hand, the crosscut saw to complete the cut.

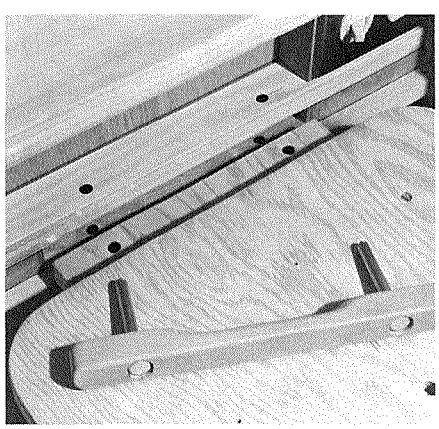


CLAMP a large board to drill press table to support the board for drilling.

TO PROVIDE access for your screwdriver, this hinge must be attached before you join the other hinge.



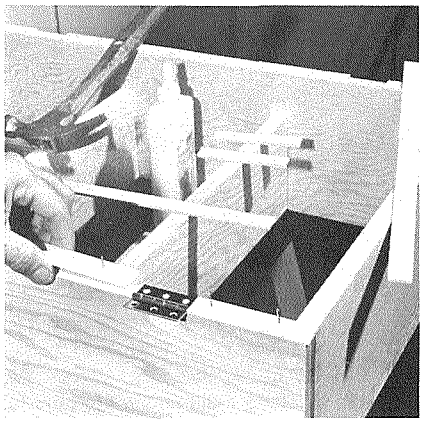
CHECK the board for an accurate plane, using a spirit level when you are locating the position of the support block. Note that the cabinet is temporarily secured to the workbench with clamps. To avoid confusion, the lower hinge is merely resting on its barrel.



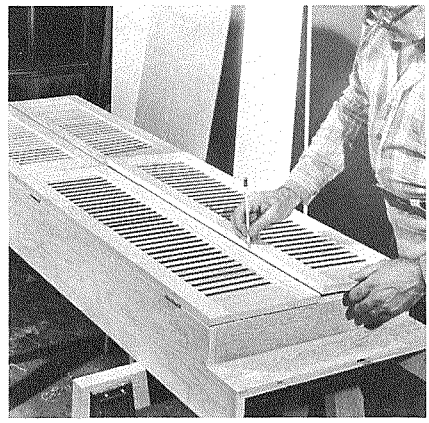
ABOVE is a close-up view of the ironing board support assembly. The pins through the handle are cut from bolts.

conceals raw plywood edges (of cabinet front), also. Glue and ¾-in. brads are used for lattice.

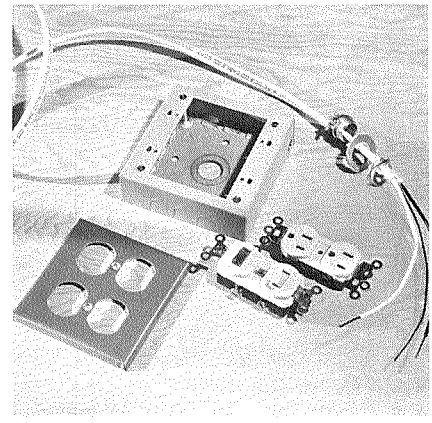
Since the stock doors are the same width as the cabinet when attached, a clearance space must be provided between them. The best way to mark the edges for cutoff is with the doors temporarily attached. Lap one door over the other; trace a pencil line for the cut so if there's a slight discrepancy in vertical alignment, you can create a perfect match.



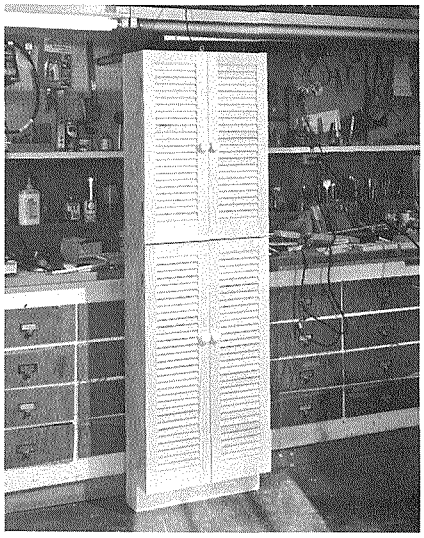
ATTACH pine strips to front edges to form the recesses for the hinges.

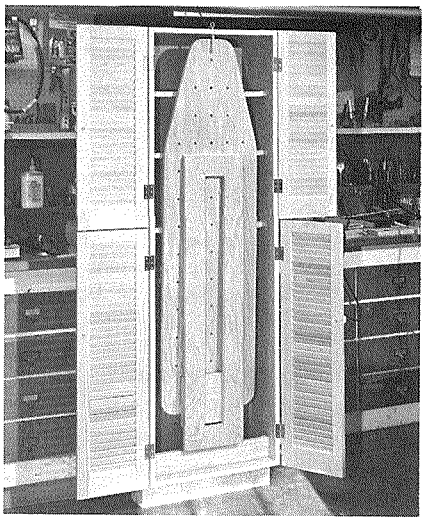


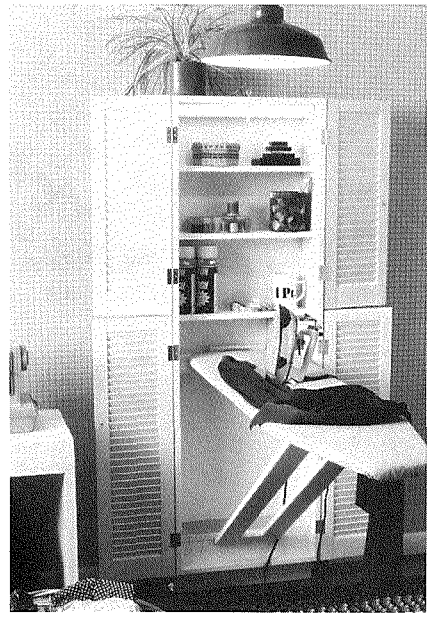
TEMPORARILY attach door panels and make necessary marks for final fit.



PARTS for electrical hookup; ground three-prong receptacle properly.





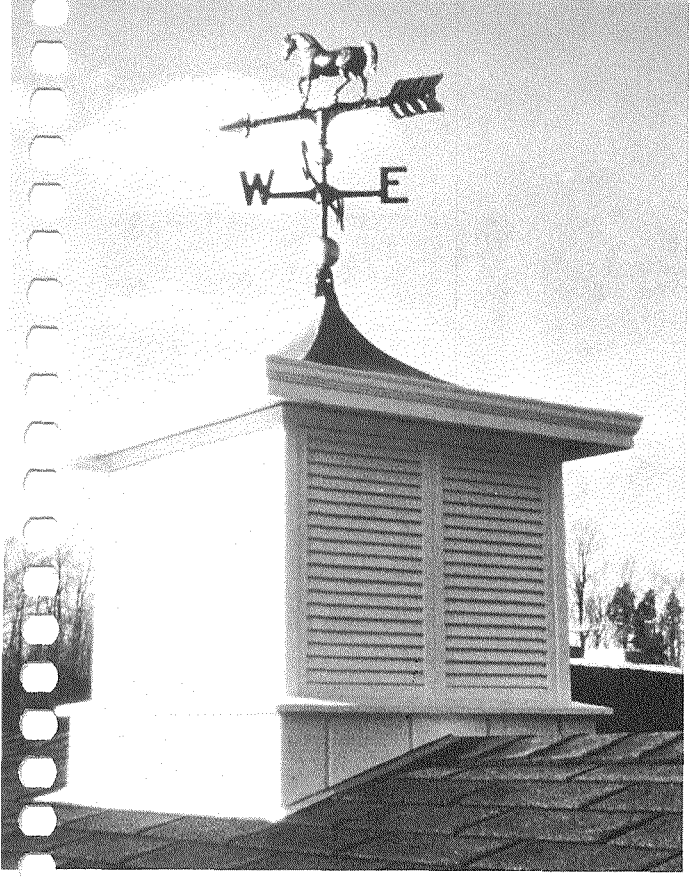


TEMPORARILY assemble the complete unit in the shop with the box set up plumb and level (above left). When the fit is correct, remove hardware and doors to paint. It is important that the ironing board swing up with a minimum of effort, and that it lock securely in place. The unit is primed and painted, then installed in the desired location (above). Installation is done with lag-screws inserted through the back into wall studs, if possible. However, four hefty toggle bolts can hold it .

MATERIALS LIST—IRONING CENTER

Key	No.	Size and description (use)
A	2	¾ × 7½ × 68" fir plywood (side)
B	1	¾ × 7½ × 18½" fir plywood (top)
C	1	¾ × 7 3/16 × 18½" fir plywood (bottom)
D	2	¾ × 5 × 18 ½" fir plywood (shelf)
E	1	¾ × 4½ × 18½" fir plywood (shelf)
F	1	¾ × 2⅛ × 18½" fir plywood (board support)
G	1	¾ × 1½ × 18½" fir plywood (board support)
H	1	¾ × 5½ × 18½" fir plywood (hot iron shelf)
I	2	¾ × 3 × 3" fir plywood (hot iron shelf cleats)
J	1	¾ × 3 × 18½" fir plywood (hinge support)
K	1	¾ × 4 × 20" fir plywood (front base)
L	1	¾ × 14½ × 54" fir plywood (ironing board)
M	1	¾ × 7 × 9" fir plywood (ironing-board extension)
N	1	¾ × 9 × 42" fir plywood (ironing-board support)
O	1	½ × 13/16 × 18½" fir plywood (board support)
P	2	½ × 13/16 × 4⅝" fir plywood (board support)
Q	1	¼ × 19¼ × 66¼" lauan plywood (back)
R	1	¾ × ¾ × 7¾" hardwood (latching peg bar)
S	1	¼ × 4 × 9" hardboard (iron bar spacer)
T	1	¼ × ⅜ × 18½" pine (iron shelf lip)
U	as reqd.	⅛ × ¾" pine (front edging; rip from 1" stock)
V	2	10 × 28" J.C. Penney A-737-3640A (shutters, fixed louver)
W	2	10 × 36" J.C. Penney A-737-3665A (shutters, fixed louver)
X	1	Lamp—J.C. Penney AJ 848-4602A (15-w. undercabinet fluorescent fixture)
Y	2	5/16 × 3½" hex-head bolt (thread section cutoff)
Z	1	⅜-dia. × 3¼" dowel (ironing-board stay)
AA	1	large cup hook (ironing-board stay)
BB	1	5¼ × 18½" aluminum flashing
CC	3	5¼ × 18½" asbestos paper
DD	8	2 × 1⅜" brass hinge
EE	2	1½ × 9" piano hinge with ¾" No. 7 screws
FF	4	porcelain knobs
GG	1	Wiremold 2-gang receptacle box
HH	1	wire clamp
II	1	donut washer (to reduce hole diameter)
JJ	1	SP switch with pilot light
KK	1	duplex receptacle
LL	as reqd.	No. 14 wire (to junction box)
MM	1	cover plate (to junction box)

Misc.: 2" finishing nails, glue.



Build a cupola—the classic cooling system

Here's a solution to the ventilation problems in your home—and an attractive addition to your roof

By ROSARIO CAPOTOSTO

■ INSTALLING A CUPOLA is an effective way of ventilating an interior, and it also adds architectural interest to your home. Our version has an eye-catching, contoured copper roof that you can fabricate in your own shop.

The main frame of the cupola is constructed of 2 x 2 kiln-dried lumber and ¾-in. fir plywood. Its base is dimensioned for a roof with a 4-in-12 slope. If your roof line differs you can alter the design to suit.

Begin by cutting the vertical members (B) of the frame. Cut the four pieces to length, making the appropriate bevel angle at the bottom ends, which depends on the angle of your roof. Cut the dadoes in these members by making a series of sawkerf cuts or use a dado head.

Cut parts A with 45° miters on all ends. Assemble the square top of the frame using 8d common nails and glue. Use four bar clamps to assure squareness.

For superior holding strength and no rust stains, all nails used in the project should be hot-dipped galvanized. Use either waterproof resorcinol glue or plastic resin glue (the latter is less costly but also water-resistant).

Cut and attach crosspieces C to the verticals using glue and 3-in. (10d) finishing nails to form an H. Join the two H-ends to the remaining crosspieces. Then add the square top frame and bracing members D and G at the bottom.

The sills (J) are of ¾-in. pine stock. Cut the 45° miter first, then notch the rear corners so they'll seat into the corner posts of the frame.

Cutting the deep bevel on the upper face of the sill is a simple task on the table saw. Face two sill pieces back to back against the rip fence; then nail a piece of plywood across both to bridge them. This allows the pieces to slide past the blade without danger. After cutting the first bevel, you rotate the pieces so you can taper the second. Then glue and nail the sills in place.

To prevent rain from entering, attach stops (L and M) to the four openings at the top, bottom and sides. Bore pilot holes in the stops for the screws to attach the shutters. One pair of the shutters is hinged to allow access to the roof from the attic.

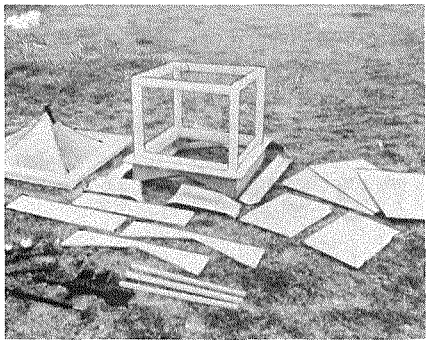
The cupola base is sheathed with ¾-in. plywood (N and O). It is finished with Champion Building Products texture 1-11 plywood. However, you may choose to finish the base to match your house siding. Cut the siding to fit, but don't nail it in place. It must be removed later, during the cupola installation, to permit application of flashing.

constructing the roof

The roof base (K) is a square of ¾-in. plywood with a center cutout. The top edge is built up of 2 x 2s (E and F) and 1 x 3 sidepieces (S and T) edged with a crown molding (U).

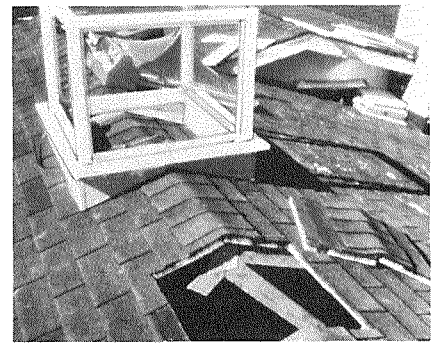
Before cutting the roofing formers (P) which give contour to the roof, you'll find it is helpful to make a cardboard template. Then cut the plywood formers on the bandsaw or with a sabre saw. Cut a top center notch in one former and a bottom center notch in the other former so they will interlock.

HOW TO TOP YOUR ROOF WITH A CUPOLA

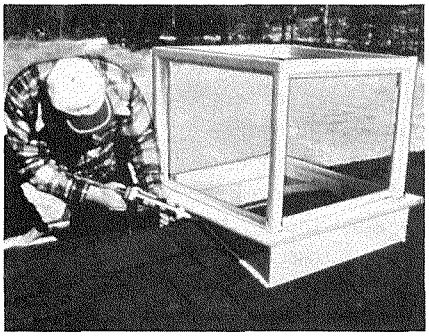


DISASSEMBLE the cupola before moving it to roof. It takes two people on separate ladders to carry the copper roof.

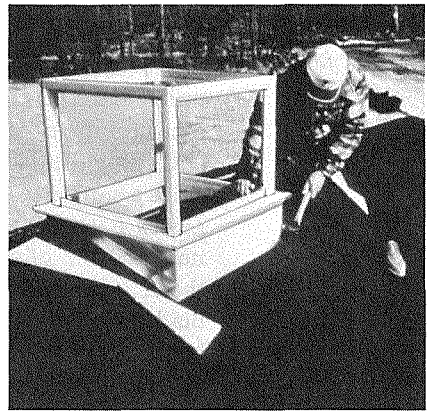
AFTER BORING four corner holes from inside, mark cutout with chalk.



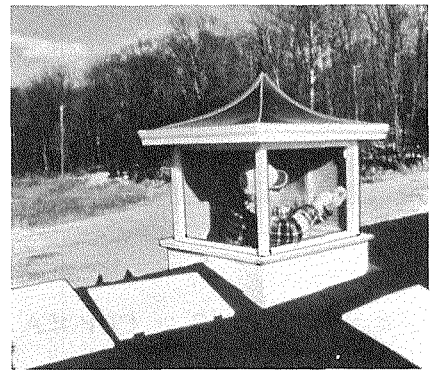
A COARSE BLADE in a sabre saw makes the cut. Pack extra blades in case you hit nails. This view shows the truss framing.



BORE ANGLED pilot holes for lag-screws through the frame and house roof after checking for plumb. Use quality caulking to seal angled sides. The straight sides don't need caulking.



INSERT flashing and the facing boards.



AFTER SECURING the roof, screw shutters in place and add center cleats.

The top edges of the formers should be beveled 45° both sides to form a common joint for the copper roof sections. This can be a tricky operation, but you can make the bevel using a piloted bevel cutter in a router as follows.

Adjust the router so the cutter projects just enough to cut 1/16-in. short of dead center of the plywood edge. When you make the second cut on the other side, the total remaining edge will be 1/8-in. This thickness is enough to guide the pilot (or the gulley between it and the blade, depending on the particular bit you use). Try a few test cuts on scrap until you get the adjustment right on target.

Cut the roof-peak support blocks (H) from 2 x 4 stock, then glue and nail them in place. To align them accurately, it helps to nail a strip of wood across the face that bridges the formers.

fabricating the copper roof

Strips of copper (Q) can be nailed to the beveled top edge of the formers to provide a soldering base for the roofing. If you make a series of cuts along both edges of the strips you can bend them along the curved former without their buckling.

Make V-cuts with shears or make straight cuts with a jig or hacksaw. The saw kerfs will allow sufficient clearance, but simple straight cuts with shears won't provide the necessary clearance to prevent buckling.

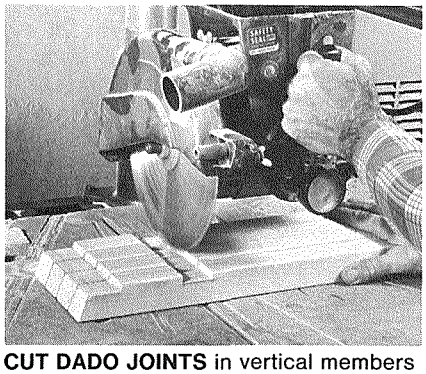
Copper is normally sold in 3 x 8-ft. sheets. However, if you take a full-size paper pattern of the roof section to a local roofing or sheet-metal contractor, you may be able to buy scraps the size you need.

To make an accurate pattern for the four sections (R) of the roof, trace directly over the roofing formers and make a cardboard template. Do this *before* you nail the copper strips on the top edges of the formers with 1-in. brass or copper escutcheon nails.

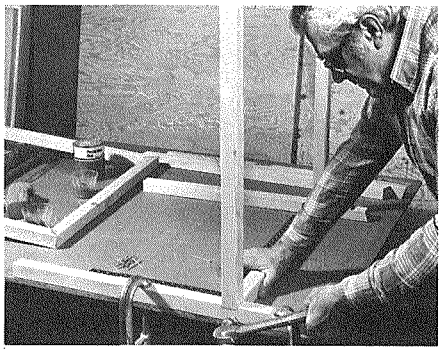
The four copper sections shouldn't butt tightly against one another. Instead, expose a 1/8-in. width of the copper strip below.

Use a sharp scriber against the template to

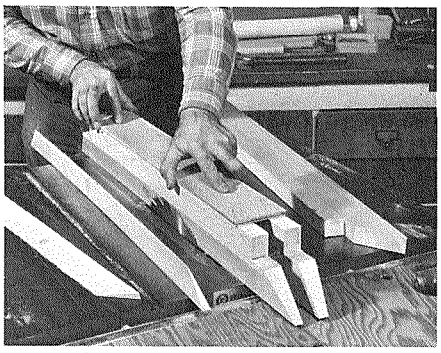
TIPS ON BUILDING THE CUPOLA



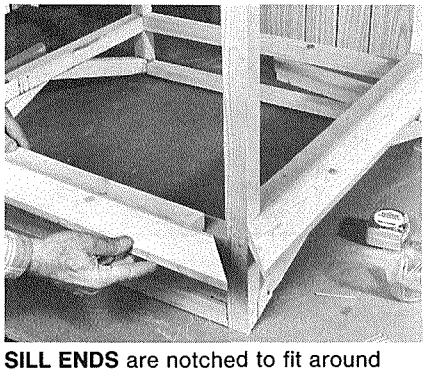
CUT DADO JOINTS in vertical members (B) by making repeat, overlapping passes with saw. Ends of these members are beveled to conform to the roof.



ASSEMBLE with glue and nails, using bar clamps if possible, to assure tight joints. Use square to check that assembly is true.

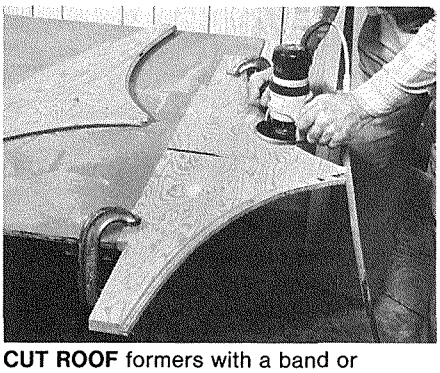


MITER-CUT the ends of the sill members (45°); then saw deep bevels on top surfaces using the setup shown. Reverse this assembly to cut second sill.

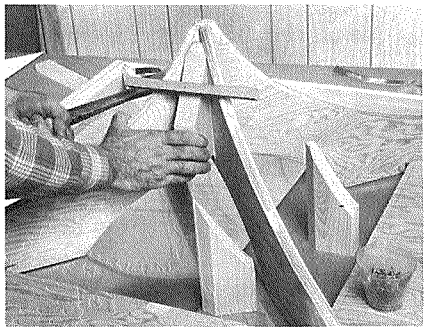


SILL ENDS are notched to fit around the corner posts. Apply glue to all joints before fitting them. Base of the frame is now ready to be sheathed.

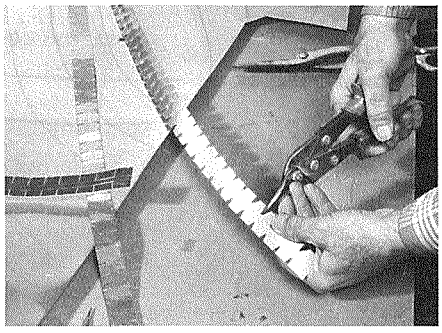
ATTACH rain stops: then bore pilot holes for screws that attach shutters. Don't add them yet, but do number each section to avoid later confusion.



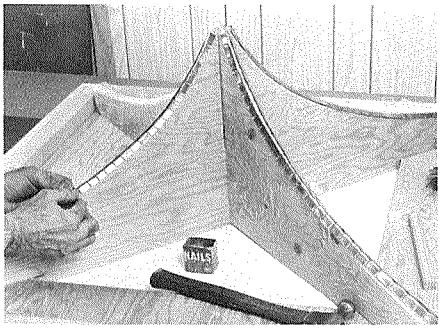
CUT ROOF formers with a band or sabre saw; shape the top edges by making two passes with router fitted with a 45° bevel cutter.



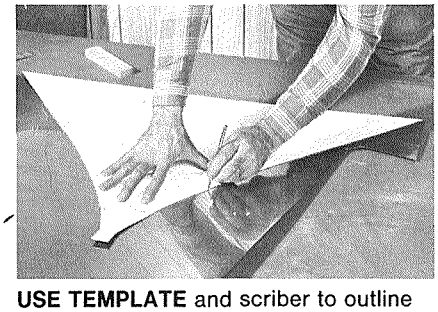
TEMPORARILY TACK-NAIL a strip of wood perpendicular to peak support blocks; this helps align blocks.



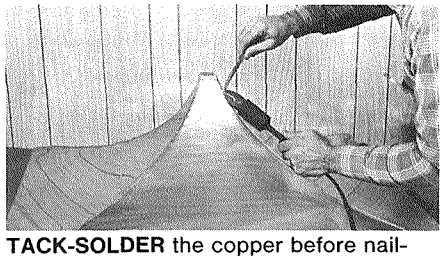
MAKE SAW KERFS or V-cuts in copper strips (Q) so they won't buckle when fitted along top edges of roofing formers.



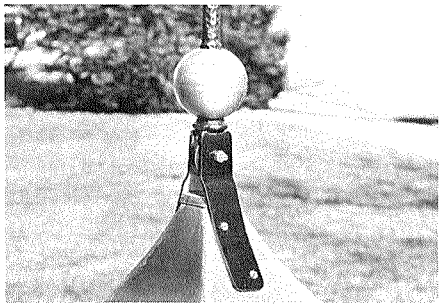
FOLD COPPER strips to conform to roof formers and nail strips in place. These provide soldering base for roof.



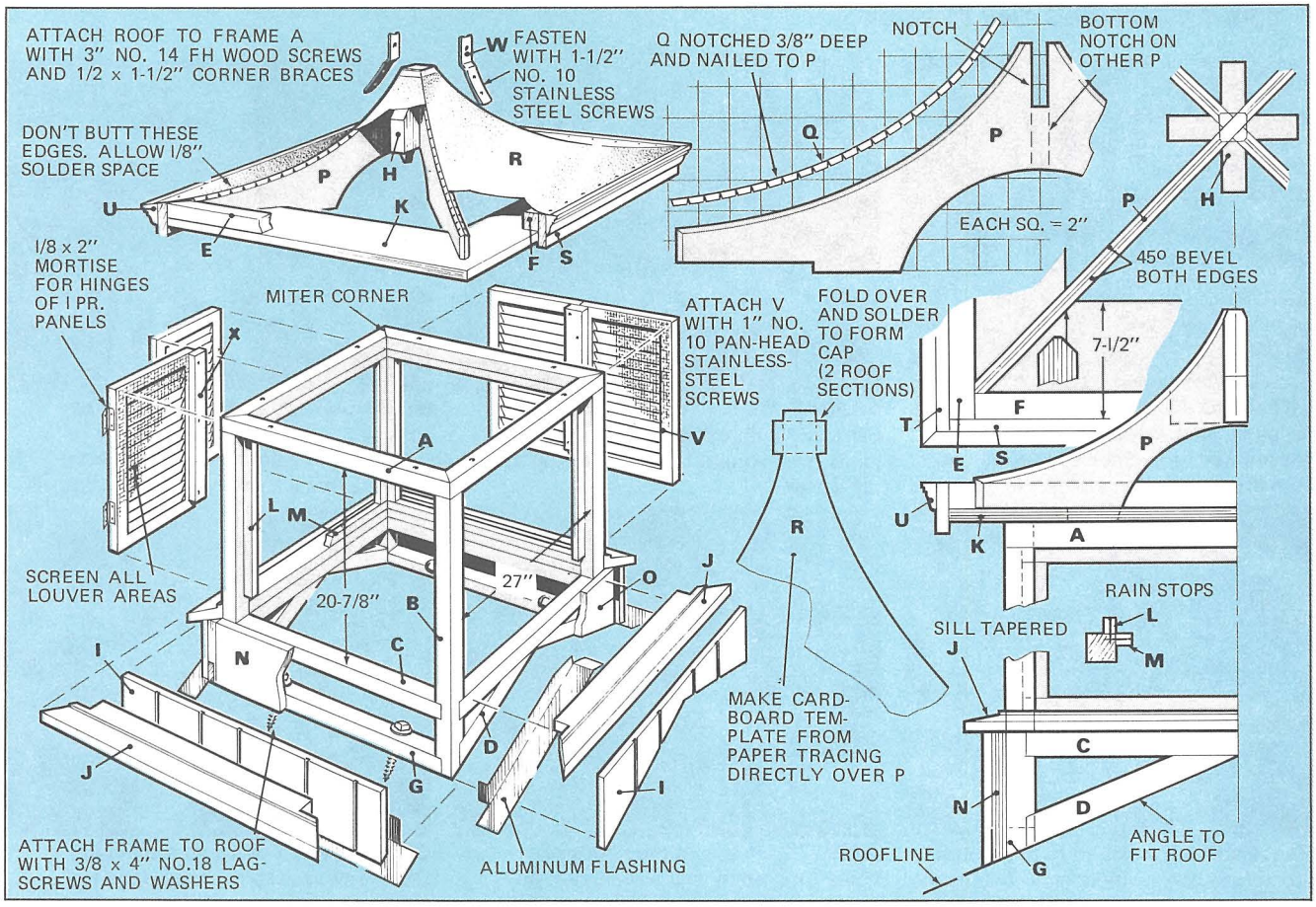
USE TEMPLATE and scriber to outline cuts for roof sections. Carefully make cuts with snips or power shear.

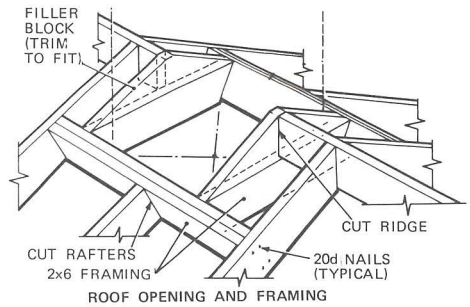


TACK-SOLDER the copper before nailing the bottoms with 1-in. brass or copper escutcheon nails; then finish soldering. Use a heavy-duty iron (not a torch) on 16-oz. copper. File off solder lumps.



WEATHERVANE BRACKET is made of ⅛-in. aluminum with stainless screws.


ATTACH ROOF TO FRAME A WITH 3" NO. 14 FH WOOD SCREWS AND 1/2 x 1-1/2" CORNER BRACES
W FASTEN WITH 1-1/2" NO. 10 STAINLESS STEEL SCREWS
Q NOTCHED 3/8" DEEP AND NAILED TO P
NOTCH
BOTTOM NOTCH ON OTHER P
DON'T BUTT THESE EDGES. ALLOW 1/8" SOLDER SPACE
EACH SQ. = 2"
45° BEVEL BOTH EDGES
1/8 x 2" MORTISE FOR HINGES OF 1 PR. PANELS
MITER CORNER
ATTACH V WITH 1" NO. 10 PAN-HEAD STAINLESS-STEEL SCREWS
FOLD OVER AND SOLDER TO FORM CAP (2 ROOF SECTIONS)
7-1/2"
SCREEN ALL LOUVER AREAS
20-7/8"
27"
RAIN STOPS
SILL TAPERED
MAKE CARD-BOARD TEM-PLATE FROM PAPER TRACING DIRECTLY OVER P
ANGLE TO FIT ROOF
ROOFLINE
ATTACH FRAME TO ROOF WITH 3/8 x 4" NO.18 LAG-SCREWS AND WASHERS
ALUMINUM FLASHING



ROOF OPENING AND FRAMING

mark the copper for cutting Then cut the parts with shears.

soldering the roof

Soldering the roof in place is a job for a heavy-duty soldering iron. A torch isn't recommended because it is difficult to control the heat of a torch.

Apply soldering flux; then tin the copper strips (Q). Tack-solder the four roof sections in place and nail the bottom of the sections to the roof

MATERIALS LIST—CUPOLA

Key	No.	Size and description (use)
A	4	1½ × 1½ × 30" kiln-dried fir (headers)
B	4	1½ × 1½ × 28-⅝" kiln-dried fir (corner posts)
C	4	1½ × 1½ × 27-⅝" kiln-dried fir (soleplates)
D	4	1½ × 1½" to suit roof slant, kiln-dried fir (brace)
E	2	1½ × 1½ × 37½" kiln-dried fir (roof frame)
F	2	1½ × 1½ × 34½" kiln-dried fir (roof frame)
G	2	1½ × 1½ × 27-⅝" kiln-dried fir, beveled to roof pitch (anchor brace)
H	4	1½ × 3¾ × 7½" fir (peak support blocks)
I	4	⅝" Champion Building Products texture 1-11 plywood cut to fit (facing)
J	4	1¼ × 3¾ × 32" pine (sills)
K	1	¾ × 37½ × 37½" plywood (roof base)
L	8	1½ × 1½ × 20⅞" kiln-dried fir (vertical rain stops)
M	8	1½ × 1½ × 24" kiln-dried fir (horizontal rain stops)
N	2	¾ × 6¾ × 31½" plywood (sheathing)
O	2	¾ × 6¾ × 32¾" plywood (sheathing)
P	2	¾ × 14½ × 48⅞" plywood (roofing formers)
Q	4	1⅛ × 29" 16-oz. cold-rolled copper sheet (former strips)
R	1	3 × 6 ft., 16-oz. cold-rolled copper sheet (4 roof panels; locate position of all panels on copper before cutting)
S	2	¾ × 2½ × 34½" pine (roof side pieces)
T	2	¾ × 2½ × 39" pine (roof side pieces)
U	4	1⅝" solid crown molding (edging trim)
V	8	15 × 24" presanded shutters, trimmed to fit (see note 1 below)
W	2	⅛ × 5" aluminum stock (weathervane brackets)
X	4	½ × 1½ × 19½" pine (cleats)

Misc.: Hot-dipped, galvanized 8d common nails; hot-dipped, galvanized 10d finishing nails; 4, 3" No. 14 fh wood screws; 1" No. 10 pan-head, stainless-steel screws; ⅜ × 4" No. 18 lag-screws and washers; 4, ½ × 1½" corner braces; 2 pair of 1-13/16 × 2" solid brass hinges; 1" brass or copper escutcheon nails; plastic resin or resorcinol glue; aluminum flashing; aluminum screening; exterior paint.

Note 1: Shutters are available from J.C. Penney, item No. A-737-3731 A; trim them to 13½ × 20-13/16".

Note 2: Weathervane with three-dimensional horse figure is available from J.C. Penney, item No. A-847-3530 A horse.

frame with 1-in. brass or copper escutcheon nails. Start soldering at the top of the seams and work downward using 50/50 solder.

Heat won't properly transfer through the soldering tip if it isn't clean and tinned. As you work, continue to apply flux and solder regularly to the tip to keep it tinned. Wipe off any excess solder with a rag. Hold the face of the soldering tip flush on the work to transfer maximum heat.

After soldering, use a file to smooth out any irregular lumps. Occasionally rub chalk in the file teeth to minimize clogging.

Use soapy water with a small amount of vinegar added to wash off the flux from the surface.

The bottom edges of the copper roof panels (R) will overhang the roof side pieces (S,T) by about ⅜ in. Apply caulking along these bottom edges of the copper where they meet the crown molding (U).

weathervane bracket

The standard attachment bracket supplied with many weathervanes could not be used on this cupola roof, due to its sharp peak. However, you can shape a bracket (W) of ⅛-in. aluminum stock.

Form the slight curves by cutting the bracket strips through scrap 2 x 2. Sandwich the aluminum between the wood and squeeze the assembly in a vise. Make the sharper bends by hammering the aluminum against an anvil or machinist's vise.

finishing the cupola

Paint all of the exposed surfaces. However, leave the insides of the shutters bare so the wood can breathe to protect against decay.

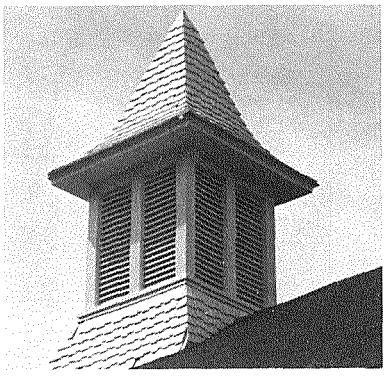
Assemble the unit completely at ground level to check fit; then disassemble the roof, shutters and base facing boards to lighten the load for transporting the cupola to the roof of the house.

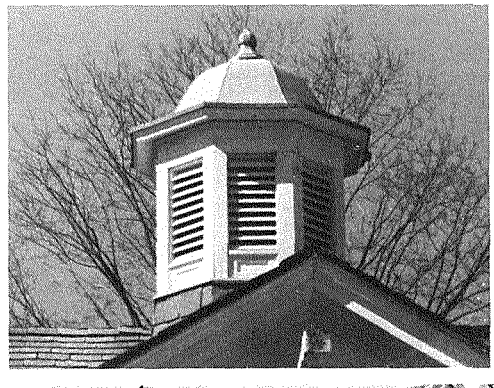
If your house roof is of truss construction, simply cut a 22-in.-square hole through the ridge. For a conventionally framed roof with a ridge board, refer to the drawing in the middle of page 40. This drawing includes details on framing an opening through a ridge.

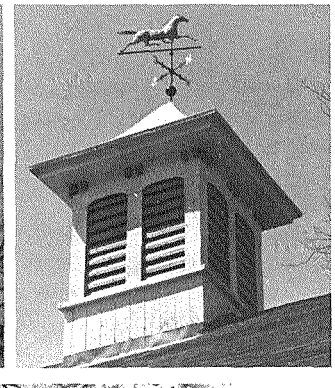
After the cupola is attached to the house roof, aluminum flashing is installed and the face boards are nailed. Next, secure the copper roof. Finally, install the shutters (V) and nail center cleats (X) to brace the shutters at the joint line. Use a compass to locate true north for positioning the weathervane.

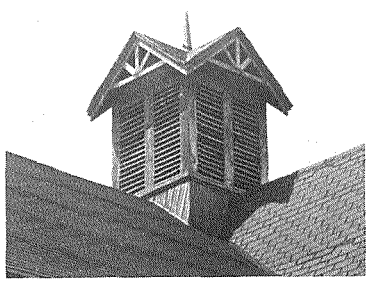
OTHER CLASSIC CUPOLAS YOU CAN ADAPT TO YOUR HOME

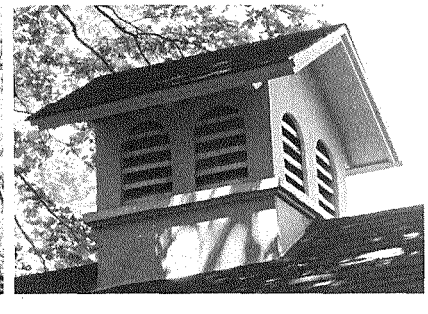
THE BASICS for building a cupola are spelled out in text and art, and it's relatively easy to adapt other styles. Cupolas shown here are examples that have been popular for a century. To avoid errors, draw plans first.



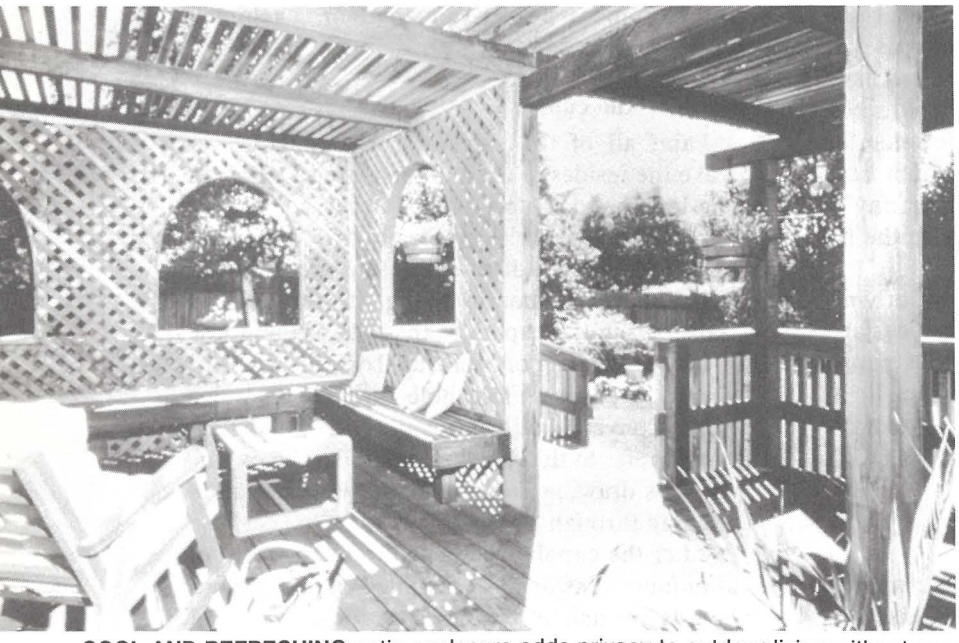


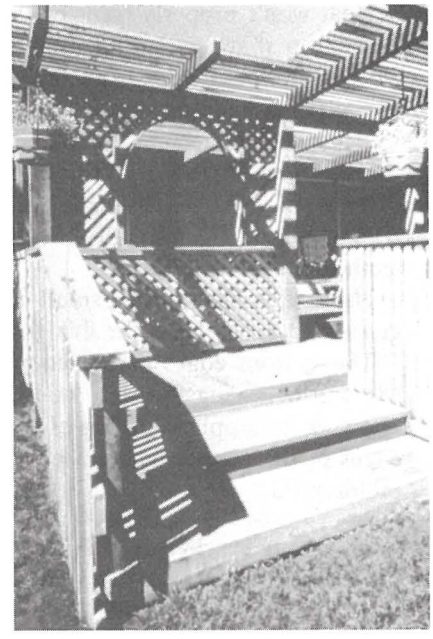






Great ways to use elegant, airy lattice





COOL AND REFRESHING patio enclosure adds privacy to outdoor living without sacrificing fresh air and sunlight.

By JOSEPH R. PROVEY

1 Deck enclosure with arched windows

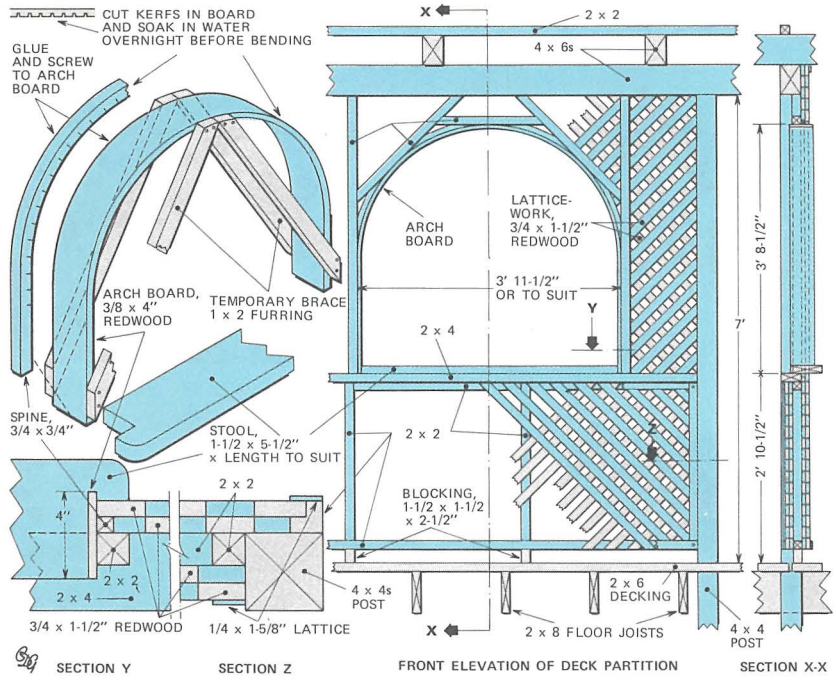
■ FOR MANY people, latticework brings to mind garden trellises, bowers and summer cottages. It is commonly used to support climbing vines—or to screen unsightly footings.

The deck enclosure with latticework walls on this page is a good example. It's built of redwood and finished with a clear, water-repellent finish (with mildewcide) to maintain a mellow redwood color.

The latticework screens provide privacy for meals and parties. They are made of 1 x 2 boards for stability, but nominal 2-in. stock, ripped to ⅜-in.-thick strips, saves money.

The enclosure frame consists of posts and beams. Run posts through the deck to concrete piers and drift pins below, or fasten them to a decking with angle fasteners (over a supporting member). Use 2 x 2s to frame openings between posts, and nail latticework to them.

To bend a 116-in.-long arch board (clear redwood) for the 47½-in.-wide window shown, cut 3/32-in.-wide kerfs, ¼ in. deep and spaced 1 in. on center. To bend the 118-in.-long spine, cut 3/32-in. kerfs, ⅝ in. deep and spaced ⅝ in. on center. Soak boards in water until they bend without splitting.



LATTICEWORK SHUTTERS and modular wall panels move garden spirit into this family room. Panels remove for painting.

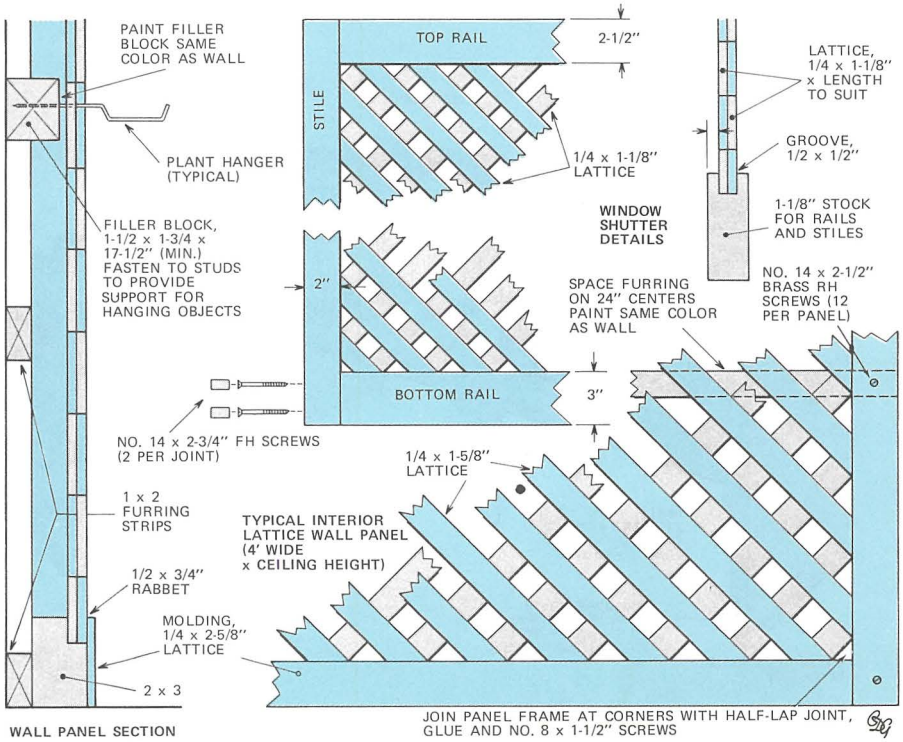
2 Window shutters and wall panels

■ A ROOM plagued by too much sunlight was transformed into this cheerfully dappled setting by adding lattice panels to the bare wall and matching shutters to the windows. Although the diamond patterns stimulate a lot of visual activity, the setting remains cool and visually relaxing.

To construct the wall panels, join members at corners with half-lap joints and screws. Install bottom layer of lattice in rabbet with glue and 1-in. brads. Space the lattice 1⅝ in. apart at 45° to the horizontal. Since each strip is a different length, you'll have to mark and cut as you go. Cut duplicates for the top layer and for other panels you plan to make. Nail down the top layer at 90° to the first and cover with trim.

To install the modular wall panels, fasten furring strips through drywall or plaster to wall studs with 10d common nails. Predrill lead holes in plaster to prevent cracks caused by nailing. Fasten the lattice panels to the furring with brass screws and washers.

Position filler blocks behind the lattice panel to provide a secure anchor wherever heavy hanging objects (such as potted plants) are desired.


PAINT FILLER BLOCK SAME COLOR AS WALL
PLANT HANGER (TYPICAL)
FILLER BLOCK, 1-1/2 x 1-3/4 x 17-1/2" (MIN.) FASTEN TO STUDS TO PROVIDE SUPPORT FOR HANGING OBJECTS
NO. 14 x 2-3/4" FH SCREWS (2 PER JOINT)
1 x 2 FURRING STRIPS
1/2 x 3/4" RABBET
MOLDING, 1/4 x 2-5/8" LATTICE
2 x 3
WALL PANEL SECTION
TOP RAIL
2-1/2"
STILE
1/4 x 1-1/8" LATTICE
WINDOW SHUTTER DETAILS
2"
BOTTOM RAIL
3"
SPACE FURRING ON 24" CENTERS PAINT SAME COLOR AS WALL
1/4 x 1-5/8" LATTICE
TYPICAL INTERIOR LATTICE WALL PANEL (4' WIDE x CEILING HEIGHT)
LATTICE, 1/4 x 1-1/8" x LENGTH TO SUIT
GROOVE, 1/2 x 1/2"
1-1/8" STOCK FOR RAILS AND STILES
NO. 14 x 2-1/2" BRASS RH SCREWS (12 PER PANEL)
JOIN PANEL FRAME AT CORNERS WITH HALF-LAP JOINT, GLUE AND NO. 8 x 1-1/2" SCREWS

Patio design for 1, Robert Gallagher; patio and bar design for 3, Steve Morgan; photos for 1 and 3, Carl Riek courtesy of the California Redwood Assn.; photos for 2 and 4, Wood Moulding & Millwork Producers.

Simple shutters with stiles and rails grooved for the lattice may be butt-joined at the corners—or use the joint shown on page 45 for long window shutters. Preassemble the latticework with glue and trim to size on a table saw using a veneer cutting blade.

3 Patio bar

■ FREQUENT TRIPS to the kitchen make it hard for a host to enjoy patio entertaining. A patio bar stocked with party provisions ahead of time will save you many round trips.

Bar construction is straightforward. Use 10d galvanized common nails to attach the sides to top cleats and the floor. Use 4d finishing nails to fasten lower cleats to the upright members and shelves to the cleats.

Allow ¼-in. gaps between top and shelf boards to prevent water standing on surfaces. Another important consideration: The top should overhang the front at least 5 in. to provide legroom when the bar is being used by a person seated on a stool.

Rip ⅜-in.-thick strips from nominal 2-in. stock scrap for the latticework bar front (or use 1 x 2 stock and 6d nails). To assemble, fasten the horizontal strips to the vertical bar members first, using 4d galvanized finishing nails. Space them 1½ in. apart. Then nail on the outside layer with 6d galvanized finishing nails (8d nails of nominal 1-in. stock) at top and shelf level.

A color brochure on redwood garden shelters and redwood deck finishes is available for 50 cents postpaid from the California Redwood Assn., 1 Lombard St., San Francisco, CA 94111.

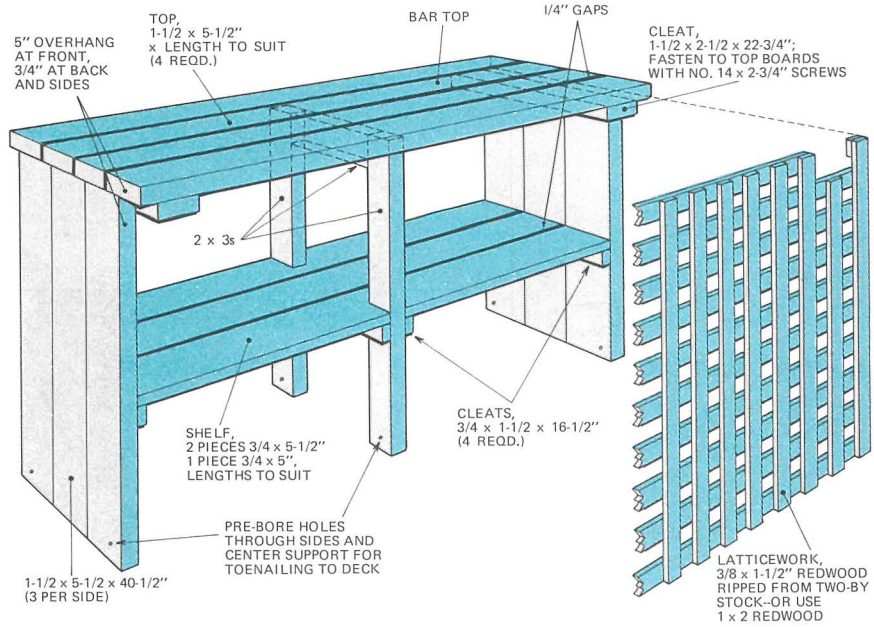
3 GARDEN-GRADE REDWOODS

Construction Heart (all heartwood) is recommended for posts, joists, stringers and all near-ground applications.

Construction Common (contains sapwood) is good for decking, fencing, trellises, benches and trim.

Merchantable (has larger knots, more sap, but can be cut economically for small applications) is used mainly for planters and rails and may be ripped to provide boards for the latticework projects.

REDWOOD PATIO BAR, fronted with a decorative latticework, makes this airy deck enclosure even more convenient for back-yard parties and get-togethers.


5" OVERHANG AT FRONT, 3/4" AT BACK AND SIDES
TOP, 1-1/2 x 5-1/2" x LENGTH TO SUIT (4 REQD.)
BAR TOP
1/4" GAPS
CLEAT, 1-1/2 x 2-1/2 x 22-3/4"; FASTEN TO TOP BOARDS WITH NO. 14 x 2-3/4" SCREWS
2 x 3s
SHELF, 2 PIECES 3/4 x 5-1/2" 1 PIECE 3/4 x 5", LENGTHS TO SUIT
CLEATS, 3/4 x 1-1/2 x 16-1/2" (4 REQD.)
PRE-BORE HOLES THROUGH SIDES AND CENTER SUPPORT FOR TOENAILING TO DECK
1-1/2 x 5-1/2 x 40-1/2" (3 PER SIDE)
LATTICEWORK, 3/8 x 1-1/2" REDWOOD RIPPED FROM TWO-BY STOCK--OR USE 1 x 2 REDWOOD

PERSPECTIVE VIEW

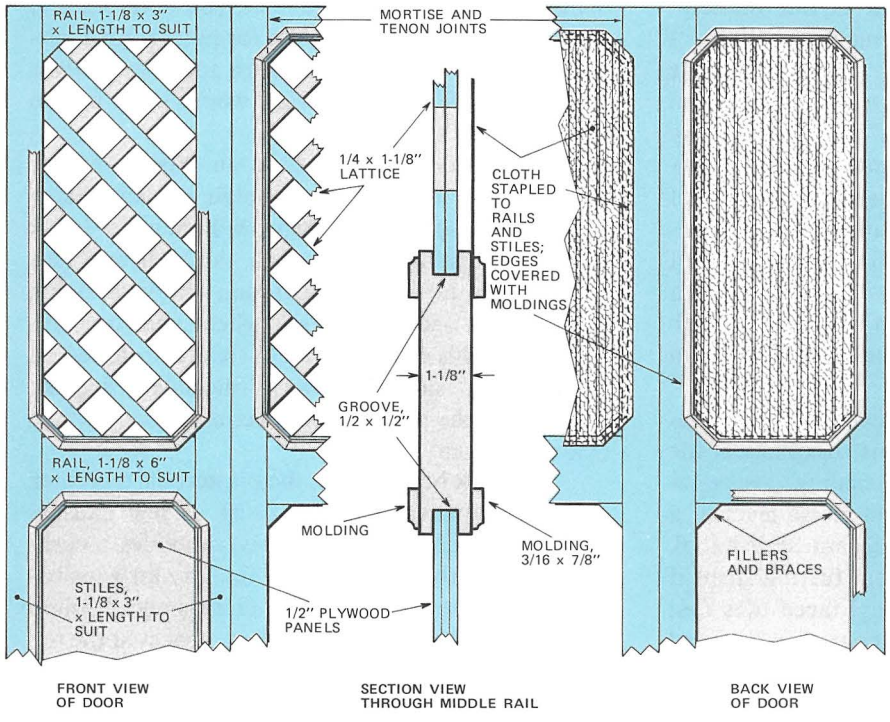
4 Door and window treatments

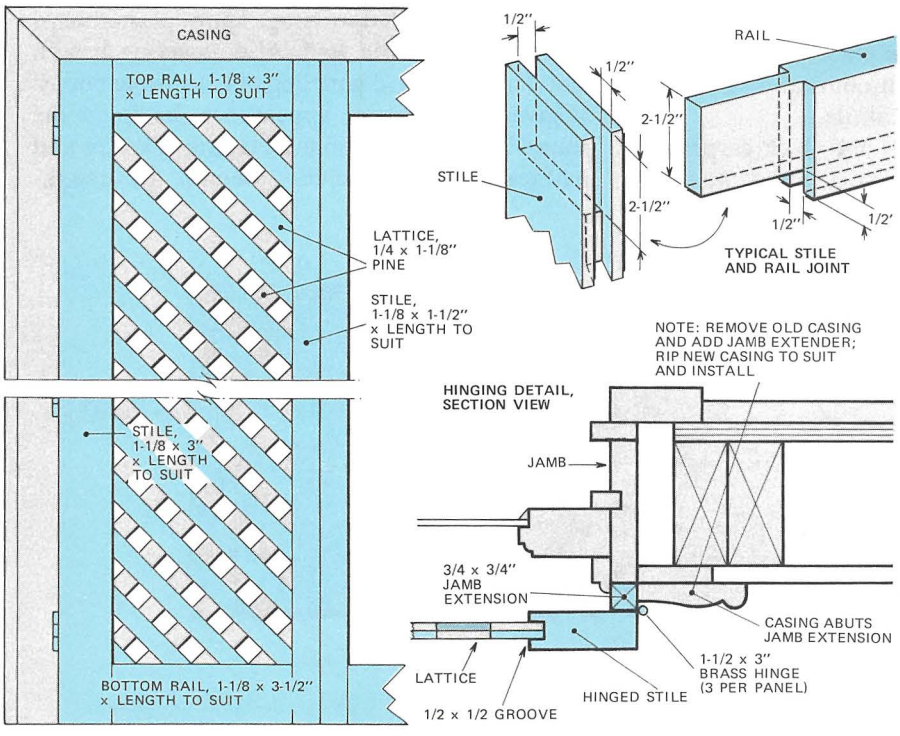
A ROOM can look crowded if it includes too many nonunified elements. One solution is to streamline, as depicted in the vanity-closets ensemble and window screens below.

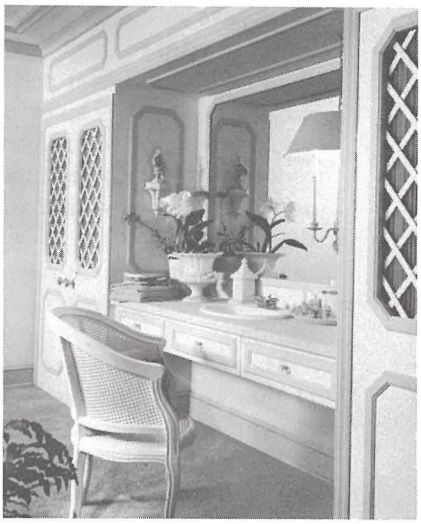
Before assembling the closet doors, preassemble the latticework insert using ⅜-in. staples on the unseen side. Space the lattice 3 in. apart at 45° to the horizontal.

To install long shutters, a jamb extender must be used to provide clearance at the stool. The extender must be wider than shown in the plans for stools which extend more than ¾ in. from wall.

For a brochure on lattice, write to Wood Moulding & Millwork Producers, Box 25278, Dept. PM 680, Portland, OR 97225.


RAIL, 1-1/8 x 3" x LENGTH TO SUIT
MORTISE AND TENON JOINTS
1/4 x 1-1/8" LATTICE
CLOTH STAPLED TO RAILS AND STILES; EDGES COVERED WITH MOLDINGS
1-1/8"
GROOVE, 1/2 x 1/2"
RAIL, 1-1/8 x 6" x LENGTH TO SUIT
MOLDING
MOLDING, 3/16 x 7/8"
FILLERS AND BRACES
STILES, 1-1/8 x 3" x LENGTH TO SUIT
1/2" PLYWOOD PANELS
FRONT VIEW OF DOOR
SECTION VIEW THROUGH MIDDLE RAIL
BACK VIEW OF DOOR


CASING
TOP RAIL, 1-1/8 x 3" x LENGTH TO SUIT
LATTICE, 1/4 x 1-1/8" PINE
STILE, 1-1/8 x 1-1/2" x LENGTH TO SUIT
STILE, 1-1/8 x 3" x LENGTH TO SUIT
BOTTOM RAIL, 1-1/8 x 3-1/2" x LENGTH TO SUIT
1/2"
1/2"
RAIL
STILE
2-1/2"
2-1/2"
1/2"
1/2"
TYPICAL STILE AND RAIL JOINT
NOTE: REMOVE OLD CASING AND ADD JAMB EXTENDER; RIP NEW CASING TO SUIT AND INSTALL
HINGING DETAIL, SECTION VIEW
JAMB
3/4 x 3/4" JAMB EXTENSION
CASING ABUTS JAMB EXTENSION
1-1/2 x 3" BRASS HINGE (3 PER PANEL)
LATTICE
HINGED STILE
1/2 x 1/2 GROOVE



FOR FORMAL indoor effects, lattice was used in closet (above) and dining-room shutters (below).

How to hush a noisy house

By SHELDON M. GALLAGER

■ TODAY, the mounting din of our modern, mechanized way of life is making the problem of noise more serious than ever. Experts estimate that the general level of noise in our environment is rising at the ominous rate of one decibel every year. This may not sound like much until you realize that the decibel scale is *logarithmic,* not arithmetic—a small jump in number can represent a very large jump in actual volume. A rise of only 10 decibels (db) amounts to a 100-percent increase or a *doubling* of sound intensity. At 1 db a year, the level of sound around us can double in only 10 years' time.

If you want to quiet noise *within* a room, concentrate on absorbent materials. Accoustical tile is easily put up over an existing ceiling, costs relatively little, and will reduce the noise level in a room by 5 to 10 db. It has an elegant, stylish look and can be set in mastic without furring strips if the ceiling is smooth. New vinyl-faced tiles that are water- and grease-resistant can now be used in kitchens and bathrooms where older types couldn't.

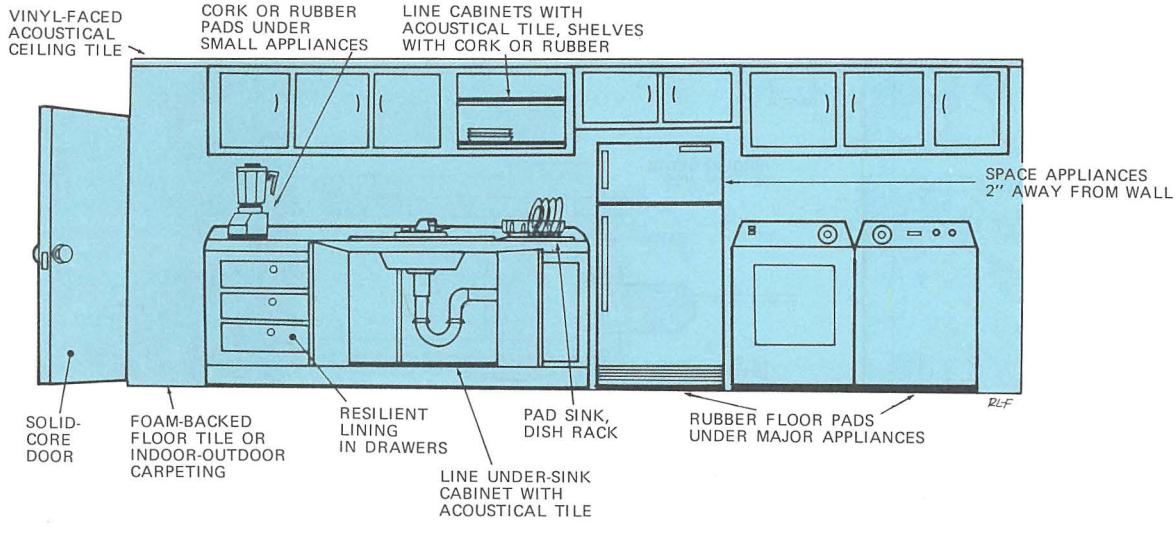
Major appliances—refrigerators, dishwashers, clothes washers, dryers—will run more quietly if carefully leveled and set on vibration-absorbing pads. Small appliances can be placed on cork or rubber mats. Kitchen and bathroom cabinets can be lined with cork or acoustical tile.

Heavy drapes hung in folds and thick carpeting with underlayment will also cut room noise by 5 to 10 db. And remember, you don't *have* to have a window as an excuse for putting up a curtain—many attractive, modern room treatments feature fully curtained walls where there are no windows at all.

Adding a sound barrier to an existing wall is easier than it may seem. Applying a new facing of inexpensive plasterboard will help to block sound from passing through the wall and is a good way to quiet a bedroom, study or living room that backs up to a kitchen, bath or playroom. In this case, the new surface is installed on the "noisy" side of the wall—the side facing the source of the sound—to reflect noise back where it came from.

The trick here is to set the plasterboard in thick beads of panel adhesive, using as few nails as possible. The resilient adhesive provides a cushion to absorb vibration, and the tiny air gaps between the new and old wall facings act as sound traps. Another trick: Leave ¼-in. spaces at the top and bottom of the plasterboard and fill these with caulking. The spaces isolate the plasterboard, to prevent noise transmission through the floor and ceiling, and are concealed by moldings.

For added soundproofing, apply plasterboard to both sides of the wall. Also, covering it with wood or hardboard paneling offers a triple bonus: It gives an attractive appearance, beefs up the sound barrier and eliminates taping of seams and nailheads (though cracks should be rough-


VINYL-FACED ACOUSTICAL CEILING TILE
CORK OR RUBBER PADS UNDER SMALL APPLIANCES
LINE CABINETS WITH ACOUSTICAL TILE, SHELVES WITH CORK OR RUBBER
SPACE APPLIANCES 2" AWAY FROM WALL
SOLID-CORE DOOR
FOAM-BACKED FLOOR TILE OR INDOOR-OUTDOOR CARPETING
RESILIENT LINING IN DRAWERS
LINE UNDER-SINK CABINET WITH ACOUSTICAL TILE
PAD SINK, DISH RACK
RUBBER FLOOR PADS UNDER MAJOR APPLIANCES
RLF

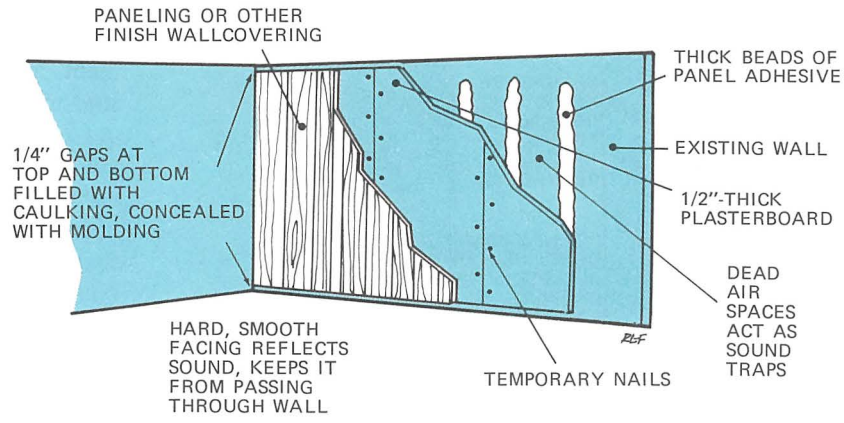
HOW TYPICAL NOISES COMPARE IN INTENSITY

SOUND LEVEL IN DECIBELS (dbA scale)

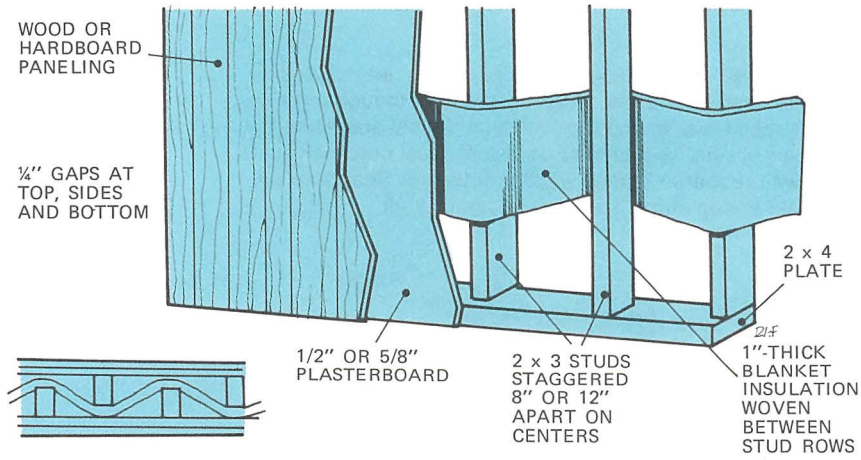
150	Jetliner at takeoff, physical damage to ear
140	Threshold of pain
130	Machine gun, riveter
120	Threshold of discomfort, rock band at peak, thunderclap
115	Chain saw, snowmobile up close
110	Loud hi-fi, construction noise
105	Power mower, outboard, light airplane
100	Interior of subway, table saw,shipyards, boiler factories
95	Jackhammer, motorcycle, food blender
90	Peak kitchen noise, heavy truck, cocktail party
85	Interior of car at high speed, household vacuum cleaner
80	Buses, trains, rush-hour traffic, garbage disposer, clothes washer
75	Dishwasher, passenger car at 20 ft.
70	Business office, electric drill, airconditioner
65	Average department store, typewriter, clothes dryer
60	Normal conversation, average urban living room
50	Average street noise, average suburban living room
40	Refrigerator
30	Warm-air heating system, average bedroom at night
20	Soft whispers, leaves rustling, watch ticking
10	Normal breathing
0	Threshold of hearing

Note: The sound levels given above were compiled from a number of sources and necessarily represent some arbitrary compromises. Actual levels may vary considerably under different conditions.

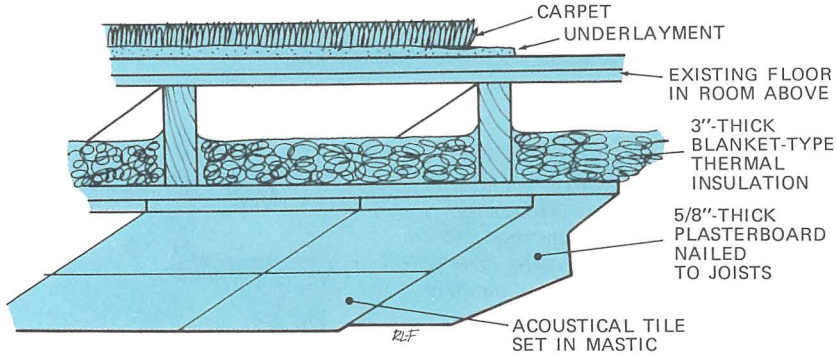
THE KITCHEN is usually the noisiest room in the house. As shown in the drawing at the left, you can do a few simple things to help bring the roar under control. Be sure appliances are level and rest on rubber floor pads. Lining cabinets and drawers also helps.


PANELING OR OTHER FINISH WALLCOVERING
THICK BEADS OF PANEL ADHESIVE
EXISTING WALL
1/2"-THICK PLASTERBOARD
1/4" GAPS AT TOP AND BOTTOM FILLED WITH CAULKING, CONCEALED WITH MOLDING
DEAD AIR SPACES ACT AS SOUND TRAPS
HARD, SMOOTH FACING REFLECTS SOUND, KEEPS IT FROM PASSING THROUGH WALL
TEMPORARY NAILS

ADDING NEW WALL facing of plasterboard on inside of a noisy room will help stop sound from carrying to adjacent bedroom or other area where you want quiet. Set sheets in beads of panel adhesive, using only enough nails to hold them temporarily in place. Adhesive acts as a cushion. Leave ¼-in. gaps at top and bottom to isolate plaster-board and keep it from transmitting sound through ceiling and floor.


WOOD OR HARDBOARD PANELING
¼" GAPS AT TOP, SIDES AND BOTTOM
2 x 4 PLATE
1/2" OR 5/8" PLASTERBOARD
2 x 3 STUDS STAGGERED 8" OR 12" APART ON CENTERS
1"-THICK BLANKET INSULATION WOVEN BETWEEN STUD ROWS

STAGGERED-STUD WALL makes ideal partition in a basement playroom or other high-noise area. Offsetting 2 x 3 studs on 2 x 4 plates isolates opposite wall faces so they don't touch and can't transmit sound. Weaving 1-in.-thick, blanket-type insulation between stud rows further reduces sound. Cover each side of wall with layer of plasterboard followed by paneling. Leave ¼-in. gaps all around; caulk, conceal with molding.



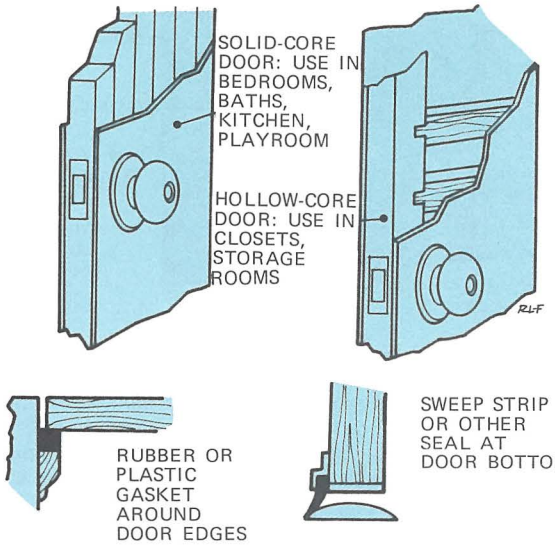
YOU CAN QUIET noise coming from a basement shop or playroom this way: Staple 3-in.-thick, blanket-type insulation between ceiling joists. Then nail plasterboard to joists and cover with acoustical tile set in mastic. The plasterboard and insulation reduce sound transmitted upstairs; the tile helps to muffle noise in the basement.

caulked to prevent noise leaks).

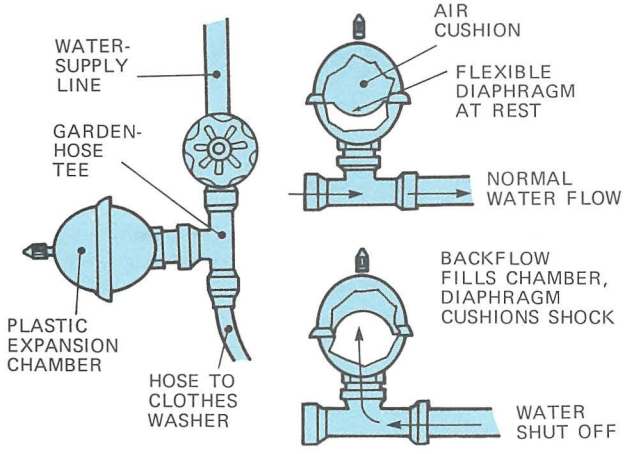
If you're putting up a new partition in a basement, attic or room addition, try the staggered-stud method shown here (page 47). By alternating 2 x 3 studs at opposite edges of 2 x 4 plates, you create a gap between the two rows of uprights—neither side of the wall touches the other, providing good acoustical isolation. For added sound absorption, you can weave 1-in.-thick, blanket-type thermal insulation between the offset studs.

One of the noisiest situations is where a basement shop or playroom falls directly under a bedroom or other upstairs area where you want maximum quiet. The solution here is a barrier ceiling on the underside of the floor. If the joists are exposed, staple 3-in. insulation between them and nail up plasterboard. Then cover the plasterboard with acoustical tile set in mastic. Where the joists are enclosed, nail up furring strips and staple 1-in. insulation between them. Then put the plasterboard and the acoustical tile in place.

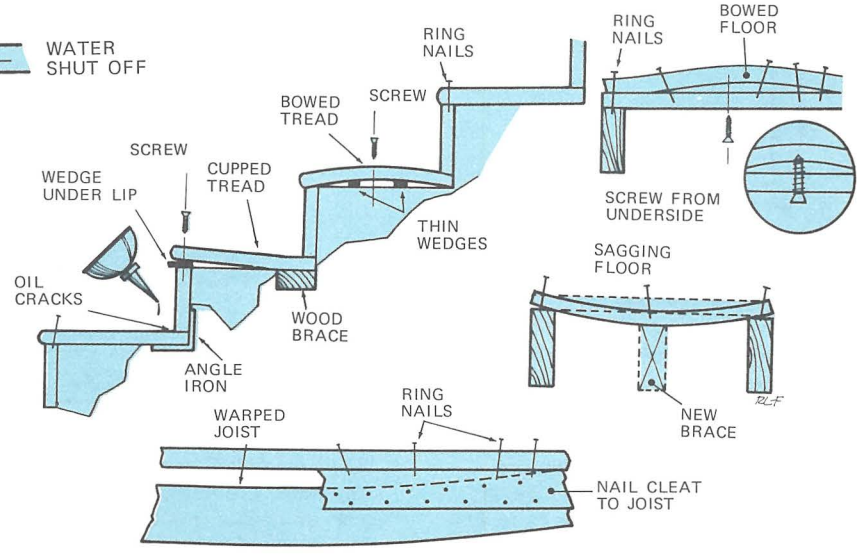
The combination of insulation, plasterboard and tile provides the best of both worlds: The hard plasterboard reflects sound, and the soft insulation and tile absorb it. Together, they block the transmission of sound upward through the floor and also soak up noise below it.


SOLID-CORE DOOR: USE IN BEDROOMS, BATHS, KITCHEN, PLAYROOM
HOLLOW-CORE DOOR: USE IN CLOSETS, STORAGE ROOMS
RLF
RUBBER OR PLASTIC GASKET AROUND DOOR EDGES
SWEEP STRIP OR OTHER SEAL AT DOOR BOTTOM

THINLY PANELED hollow-core doors vibrate, let noise pass from one room to another. Solid-core doors, though more expensive, can block sound, are better in critical areas like the bedrooms, baths, kitchen and playroom. Seal cracks around doors with rubber or plastic weatherstripping. Seal door bottoms with sweep strips that sit snug against sill.



EASY-TO-INSTALL expansion chambers can quiet noisy "water hammer" in plumbing. Plastic ball contains flexible diaphragm that absorbs sudden shocks when water flow is shut off. It can be installed in clothes-washer lines with simple garden-hose tee or in rigid plumbing with other fittings. Write to Amtrol Inc., 1400 Division Rd., West Warwick, RI 02893.



TO QUIET creaking stairs, apply mineral oil or silicone spray to joints and drive in ring nails at angle. Treads too cupped or bowed can be shimmed. Add wood or angle-iron cross braces under risers from below. Bowed floors can be pulled down tight with ring nails from above and screws up through subfloor. If floor sags, block it up with new braces. Where a warped joist no longer supports the floor, nail cleat along side to bear against floor and keep it from flexing.

Build a back-yard utility shed

By HARRY WICKS

Good design provides storage for yard tools and 3½ cords of firewood, plus 48 square feet of space for a handyman's workshop. Here are scores of good ideas to get you started on your own design

FUNCTIONAL AND ATTRACTIVE back-yard buildings are always in demand by home-owners and their families. Lack of space for storage and for pursuing outdoor interests seems to be an ongoing American problem. A back-yard building is one sensible way to solve this problem.

By building your own, rather than picking a factory-built version, you can design in all sorts of functional features that will make your lawn building efficient and fun to use. The handsome structure shown on these pages was designed by architect Lester Walker. To keep down the cost, he built his house without a slab and covered it with sheathing-grade plywood. So it would blend with his home, he covered the shed with cedar clapboard. The building is strong and its "flat" roof is slightly pitched to provide positive water runoff. Complete plans for building the shed are on the following pages.

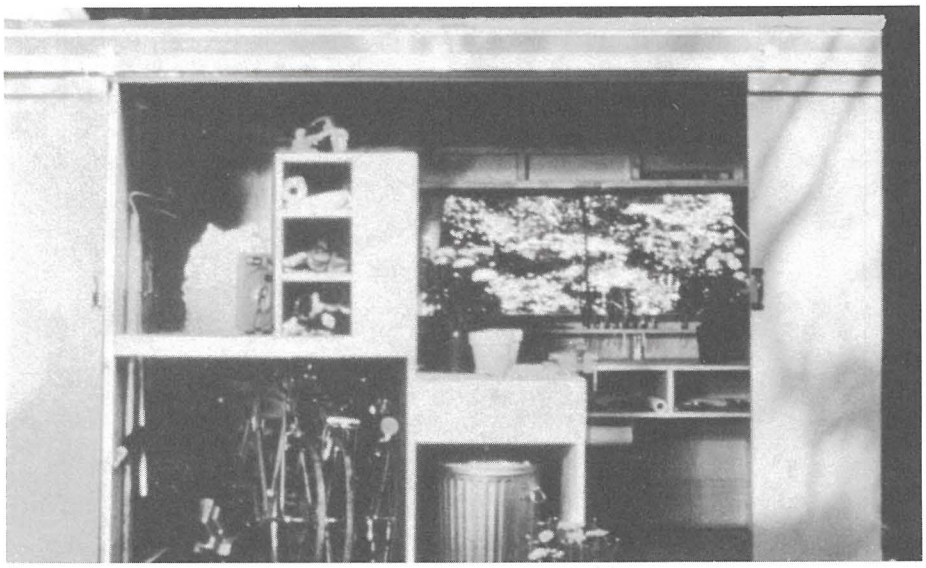
getting started

Begin by checking the area where you would like the building located to make certain that you have the space to build the shed as shown. If necessary, adjust dimensions to suit. Also, check with your local building department to assure that the structure is built in compliance with local codes.

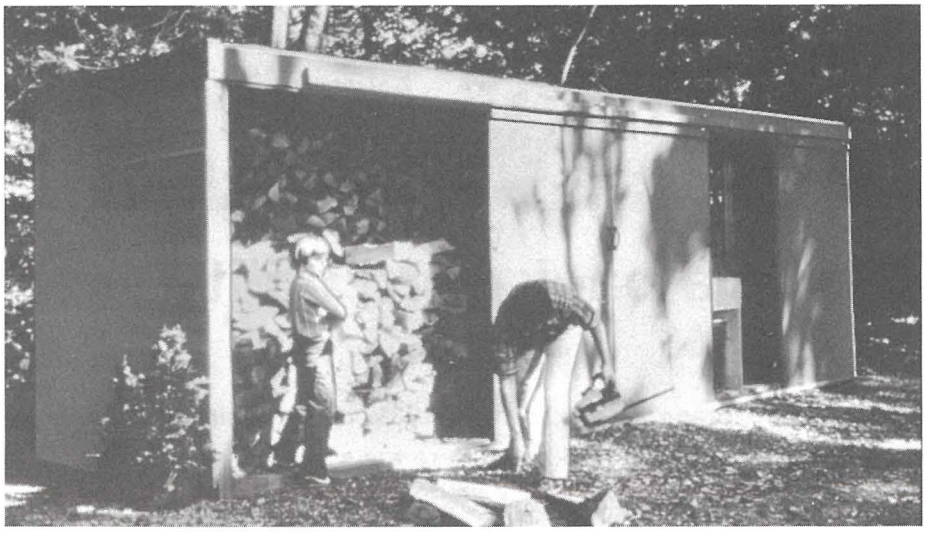
Next, using a mason's line and pointed 1 x 2 stakes, lay out the building's perimeter. Check corners for square, then locate the postholes. Excavate the postholes to a depth below your area's frost line. In most northern climates, a depth of 30 to 36 in. will be necessary. Excavate all postholes using a posthole digger, then pour gravel into each hole to a depth of 4 in.

framing the building

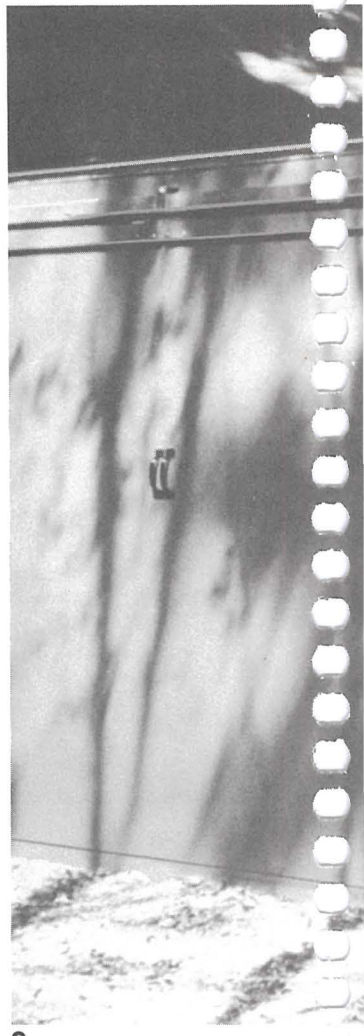
As you can see in the drawing on page 52, standard framing for an on-grade, flat-roof shed is used throughout. Before you start your framing



1

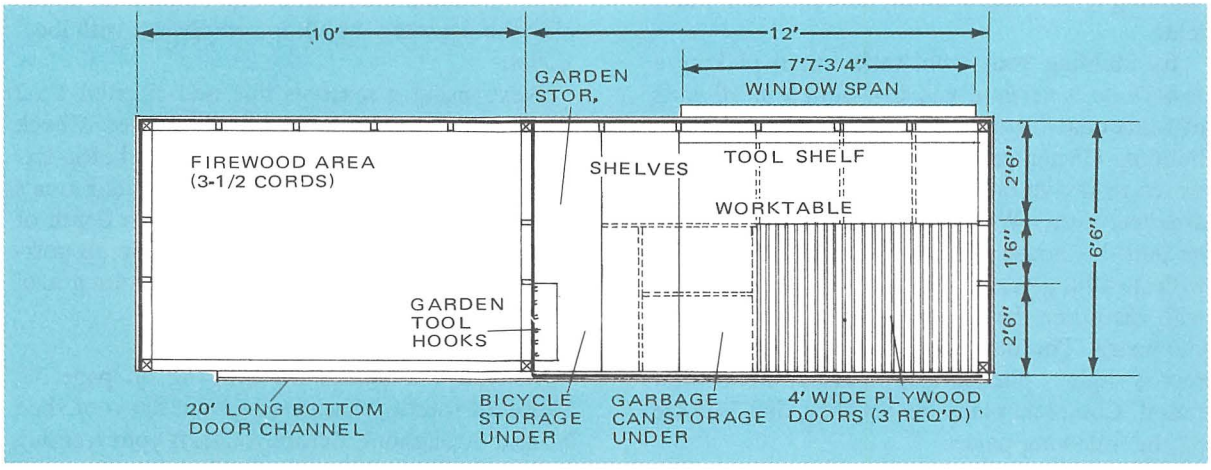


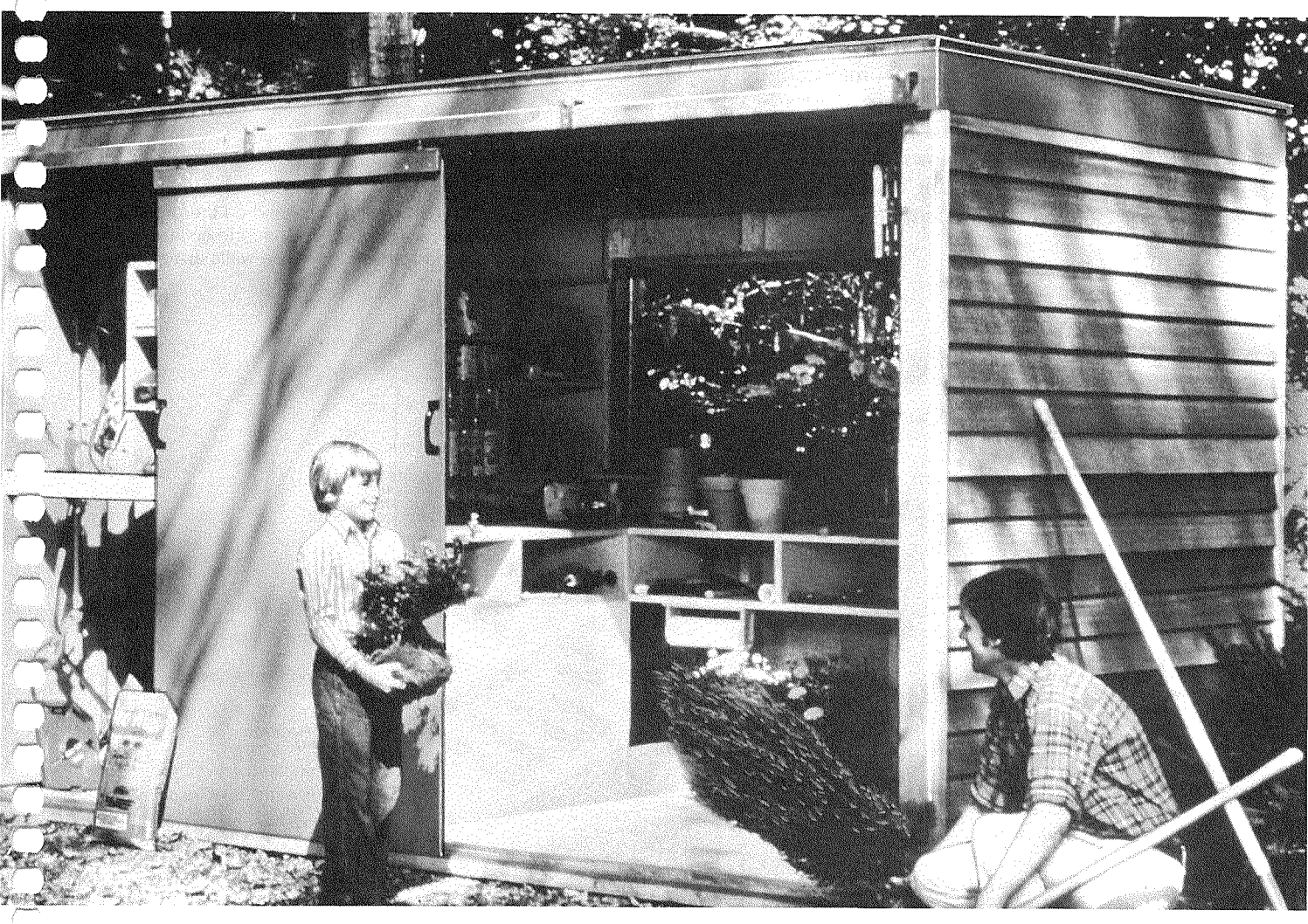
2



3

1 WHEN THE RIGHT side door is fully opened it reveals an airy workshop that is perfect for potting. Behind the bench is a storage shelf for garden supplies and bicycle storage below. 2 The end section on the left keeps up to 3½ cords of firewood dry. 3 The full utility shed is designed with uncomplicated, simple lines.





operation, study the plans carefully—see that you fully understand them. Start by assembling the end and center walls on the ground. This way, the studs can be nailed by spiking through top and bottom plates. If 4 x 4 ground beams are used as bottom wall plates throughout (as shown), the studs must be toenailed into position. Use 10d galvanized common nails.

When both end walls and the back wall are framed, enlist the aid of a helper to walk (tilt) the sections upright. Tilt one end wall to vertical and, with your helper holding it, check the frame for plumb in both vertical planes. When you're satisfied, hold the wall rigid using at least two diagonal braces. The lower ends of the braces are fastened to stakes. After securing the wall, recheck with your spirit level to make certain nothing was knocked out of position.

Repeat the procedure for the other end wall, then raise the back wall. The back wall is tied to the end walls by solid nailing at the corners. Use 16d common galvanized nails here.

When all walls are up, you can pour the concrete collars around the posts. These should be at least 18 in. deep and floated level at the top. Leave the wall diagonal bracing in place at least 24 hours while the concrete cures. Next, add the roof joists. These rest on ledger strips, which make installation a snap.

For strength and rigidity, we used exterior-grade plywood sheathing to skin the house. Use ½ in. on the walls and, for stability, ⅝ in. on the roof. Install all plywood using galvanized nails to prevent rust stains on the finished building.

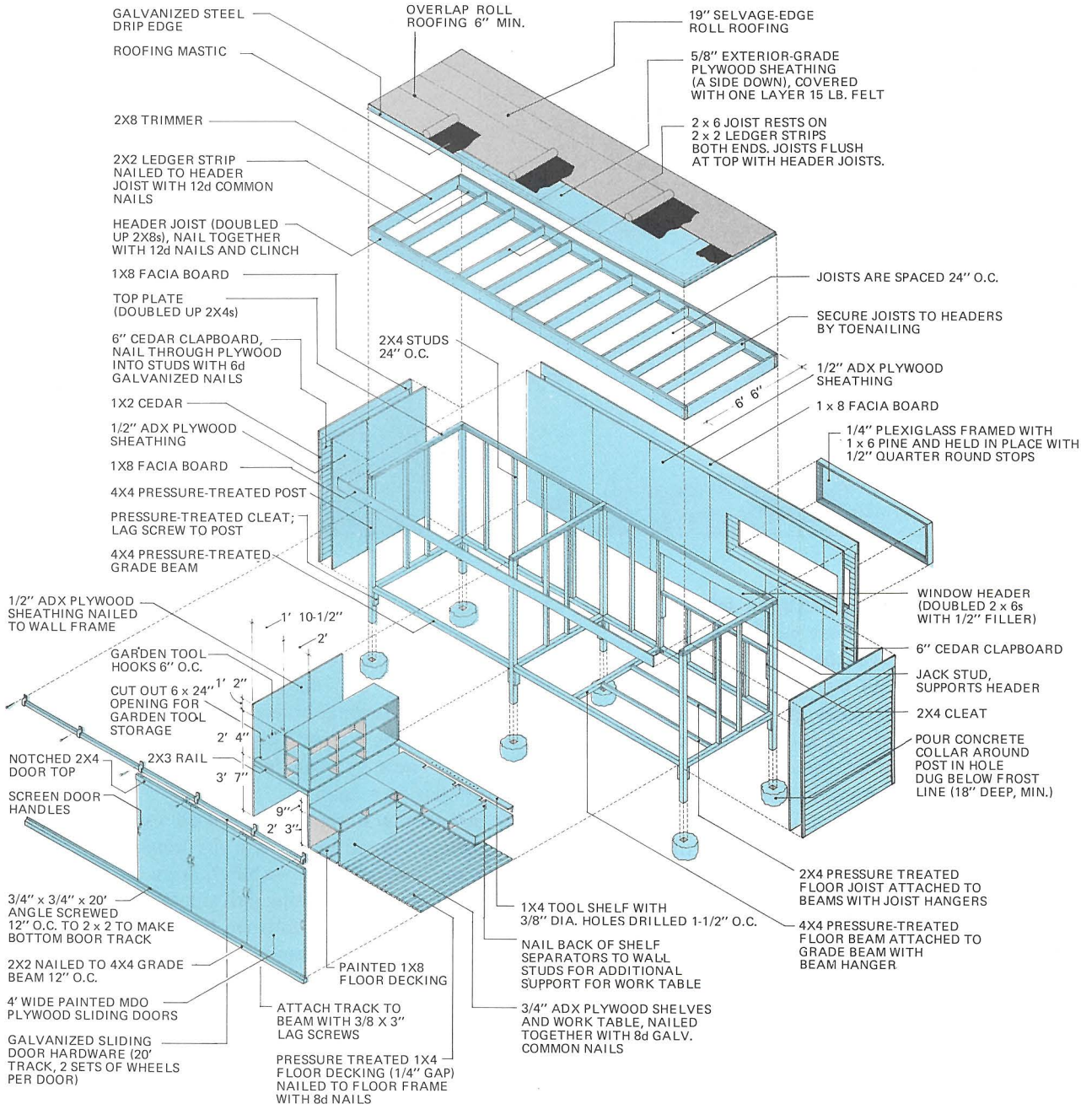
Install the 4 x 4 grade beams as shown and follow by installing the shop floor over the grade beams. You are well advised to use pressure-treated lumber for all structural members that will be in close proximity to the ground.

At the least, apply one layer of 15-lb. felt over the plywood, overlapping the material at least 12 in. Add a layer of mineral roll roofing, overlap-

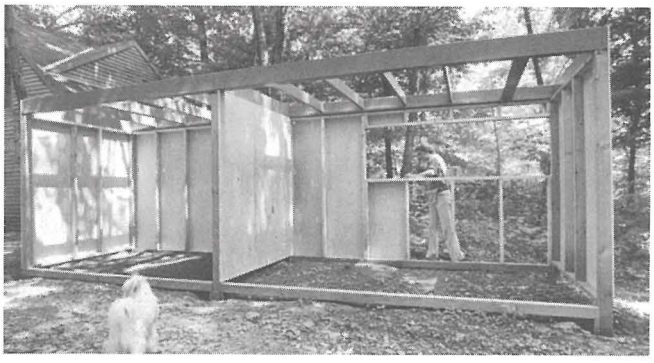
ping the nongranule portion with each following layer.

For *maximum* roofing protection: First, put down a layer of 15-lb. felt. Overlap each succeeding course at least 12 in. Next, apply a coating of hot tar. Lay down another layer of 15-lb. felt applied at a 90° angle to the first layer. Brush on a second layer of hot tar and finish by putting

SIDE AND CENTER walls are framed on the ground, then tilted in place and braced. Concrete collars can be poured around the post once the walls are plumb.

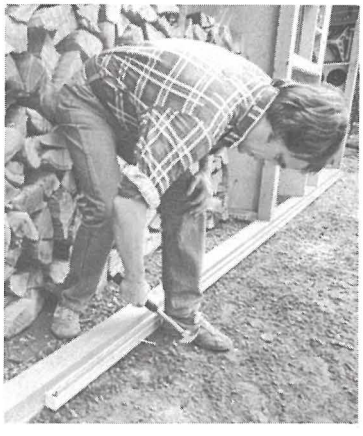

GALVANIZED STEEL DRIP EDGE
ROOFING MASTIC
2X8 TRIMMER
2X2 LEDGER STRIP NAILED TO HEADER JOIST WITH 12d COMMON NAILS
HEADER JOIST (DOUBLED UP 2X8s), NAIL TOGETHER WITH 12d NAILS AND CLINCH
1X8 FACIA BOARD
TOP PLATE (DOUBLED UP 2X4s)
6" CEDAR CLAPBOARD, NAIL THROUGH PLYWOOD INTO STUDS WITH 6d GALVANIZED NAILS
1X2 CEDAR
1/2" ADX PLYWOOD SHEATHING
1X8 FACIA BOARD
4X4 PRESSURE-TREATED POST
PRESSURE-TREATED CLEAT; LAG SCREW TO POST
4X4 PRESSURE-TREATED GRADE BEAM
1/2" ADX PLYWOOD SHEATHING NAILED TO WALL FRAME
GARDEN TOOL HOOKS 6" O.C.
CUT OUT 6 x 24" OPENING FOR GARDEN TOOL STORAGE
NOTCHED 2X4 DOOR TOP
2X3 RAIL
SCREEN DOOR HANDLES
3/4" x 3/4" x 20' ANGLE SCREWED 12" O.C. TO 2 x 2 TO MAKE BOTTOM BOOR TRACK
2X2 NAILED TO 4X4 GRADE BEAM 12" O.C.
4' WIDE PAINTED MDO PLYWOOD SLIDING DOORS
GALVANIZED SLIDING DOOR HARDWARE (20' TRACK, 2 SETS OF WHEELS PER DOOR)
1' 10-1/2"
2'
1' 2"
2' 4"
3' 7"
9"
2' 3"
OVERLAP ROLL ROOFING 6" MIN.
19" SELVAGE-EDGE ROLL ROOFING
5/8" EXTERIOR-GRADE PLYWOOD SHEATHING (A SIDE DOWN), COVERED WITH ONE LAYER 15 LB. FELT
2 x 6 JOIST RESTS ON 2 x 2 LEDGER STRIPS BOTH ENDS. JOISTS FLUSH AT TOP WITH HEADER JOISTS.
JOISTS ARE SPACED 24" O.C.
SECURE JOISTS TO HEADERS BY TOENAILING
2X4 STUDS 24" O.C.
1/2" ADX PLYWOOD SHEATHING
6' 6"
1 x 8 FACIA BOARD
1/4" PLEXIGLASS FRAMED WITH 1 x 6 PINE AND HELD IN PLACE WITH 1/2" QUARTER ROUND STOPS
WINDOW HEADER (DOUBLED 2 x 6s WITH 1/2" FILLER)
6" CEDAR CLAPBOARD
JACK STUD, SUPPORTS HEADER
2X4 CLEAT
POUR CONCRETE COLLAR AROUND POST IN HOLE DUG BELOW FROST LINE (18" DEEP, MIN.)
2X4 PRESSURE TREATED FLOOR JOIST ATTACHED TO BEAMS WITH JOIST HANGERS
4X4 PRESSURE-TREATED FLOOR BEAM ATTACHED TO GRADE BEAM WITH BEAM HANGER
1X4 TOOL SHELF WITH 3/8" DIA. HOLES DRILLED 1-1/2" O.C.
NAIL BACK OF SHELF SEPARATORS TO WALL STUDS FOR ADDITIONAL SUPPORT FOR WORK TABLE
3/4" ADX PLYWOOD SHELVES AND WORK TABLE, NAILED TOGETHER WITH 8d GALV. COMMON NAILS
PAINTED 1X8 FLOOR DECKING
ATTACH TRACK TO BEAM WITH 3/8 X 3" LAG SCREWS
PRESSURE TREATED 1X4 FLOOR DECKING (1/4" GAP) NAILED TO FLOOR FRAME WITH 8d NAILS

1

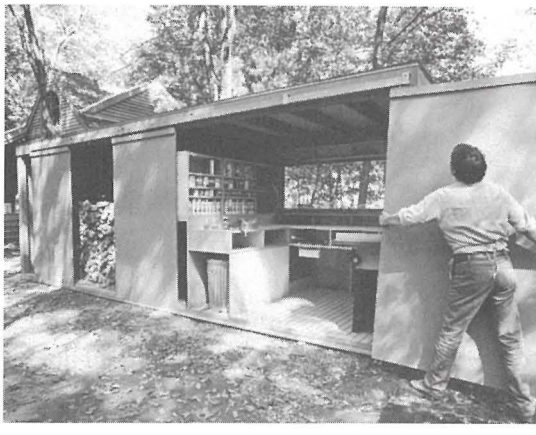


2

3



4

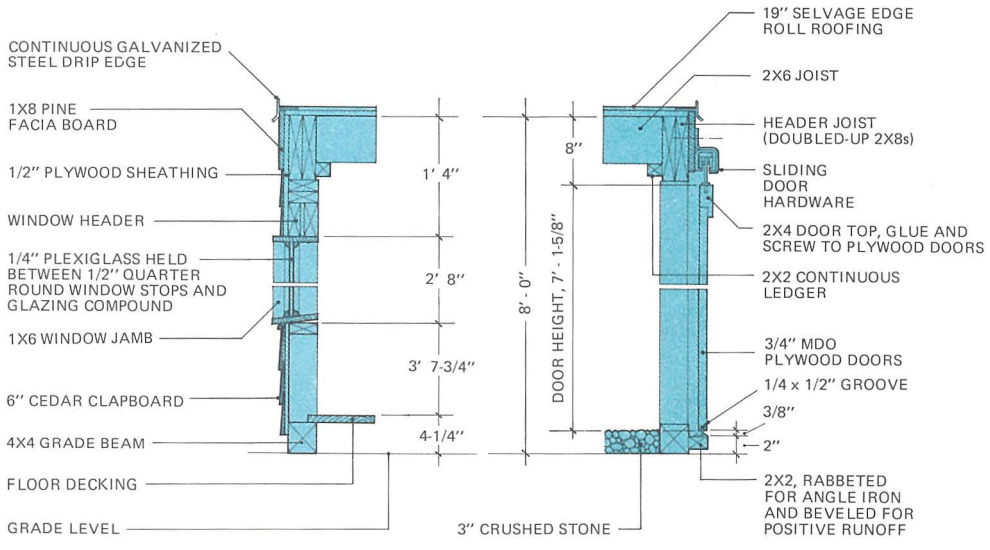


5

1 ROOF JOISTS are dropped onto ledger strips to complete the framing. 2 Sidewalls are sheathed with exterior—grade plywood that is installed with its good (A) side facing in. The end walls should be checked for square and skinned with plywood first; then you can sheath the back wall. 3 roofing consists of ⅝-in. A-D exterior-grade plywood, fastened with 6d galvanized common nails, covered with roll roofing. 4 Steel angle is attached to grade beam and becomes bottom channel for doors. 5 Doors made of MDO plywood are tilted into the lower channel.

down the mineral roll roofing.

The doors are hung barn-door fashion, using conventional hardware, and the interior is divided into sections as desired. On the prototype, designer Walker set aside enough space to hold 3½ cords of firewood. This left more than enough space for some tool storage and a modest-sized handyman's workshop. Wallboard may be used to finish the interior. If you do this, add nailers at corners.



Laundry in a closet

By JOSEPH R. PROVEY

MY WIFE AND I used to lug dirty wash down two flights of stairs to get it washed and dried—and up again to put it away. I figure that locating the washer and dryer upstairs, where dirty clothes are collected and clean ones stored, will save us from having to climb *12,000* flights of stairs during the next 10 years! Now, the distance from hamper to washer/dryer to bedroom dressers is only a few paces.

To avoid extensive alterations, choose a spot as close as possible to existing bathroom plumbing. A bedroom closet adjacent to a bathroom is ideal. Since we preferred access from the hall rather than the bedroom, it was necessary to remove a hall partition and frame in the old closet door opening.

Lay out the double doors first. Ours were set back 12 in. from where the original hall partition had been, so they would not block traffic to either bathroom or bedroom. The opening should be large enough to slide the washer and dryer through. If the units measure 27 in. across, as ours do, you will need at least a 31-in.-wide finished opening (jamb-to-jamb). This assumes that doors are to remain up during removal.

To gain width in limited space, recess the doubled studs which frame the rough opening in the walls (see plans). If the studs are being added to existing wall framing, toenail securely with 12d nails at top and bottom plates.

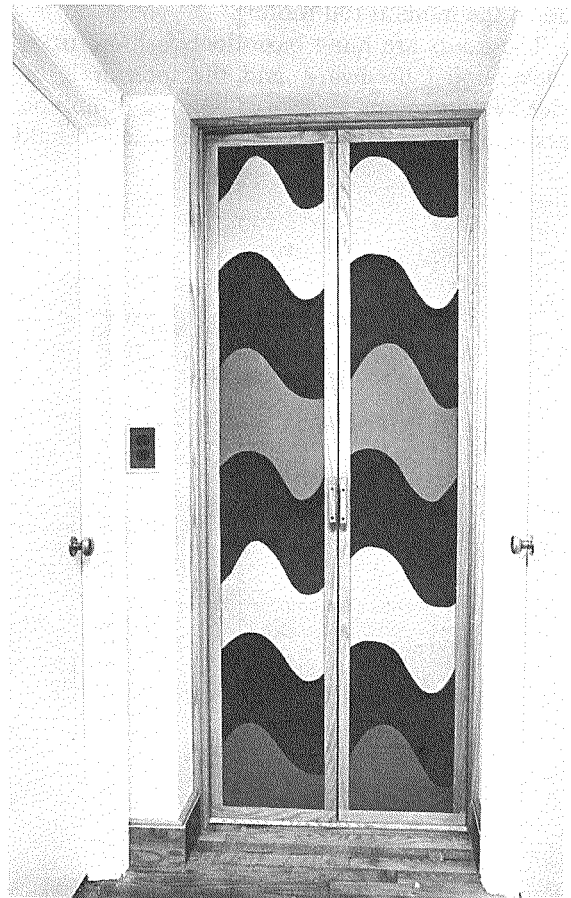
In order to hide the waste line in the common wall with the bathroom, cut notches and fur out the wall as required. Also bore holes large enough for the hot and cold supply hoses. However, don't frame in front of existing plumbing until your tie-in is made.

Finally, tear up the old flooring and nail down a piece of ¾-in. plywood to distribute the washer/dryer weight load evenly over joists.

Tapping into the existing supply and waste line isn't complicated. After turning off the main shut-off valve, cut off the air chambers a few inches above the tees which supply the bathroom sink. Small-radius pipe cutters are available for

THIS COMPACT laundry center features a fold-down sorting table and shelves for laundry aids. The washer, drier and all accessories fit neatly in a 3 x 5-ft. space that was once occupied by a closet.

THE WASHER/DRYER installation, located in an upstairs hallway, is good-looking enough for almost anywhere in your home. The double doors are covered with decorative fabric panels.



this job if there isn't space to use a larger cutter or hacksaw. Make square cuts.

Next, cut copper pipe and test-fit all fittings for the supply run. In our case, space limitations dictated the use of flexible copper tubing to join existing supply lines to the washing machine shutoff valve. When the dry assembly is satisfactory, disassemble, clean all fittings and pipe ends with fine steel wool, apply flux and reassemble for soldering. The shutoff valve and water hammer arresters are installed *after* fittings are soldered in place to prevent heat distortion.

The best way to tap into an existing drain/vent pipe is shown below. Soldering joints on large-diameter copper is easier with one of the new, extra hot propane brazing torches, such as the Spitfire from Wingaersheek.

Solder the short drain-pipe section and the male adapter to the sanitary tee before installing and soldering the tee to the drain pipe and slip coupling. When the pipes have cooled, connect the plastic female adapter to the male adapter. Use Teflon tape on threads.

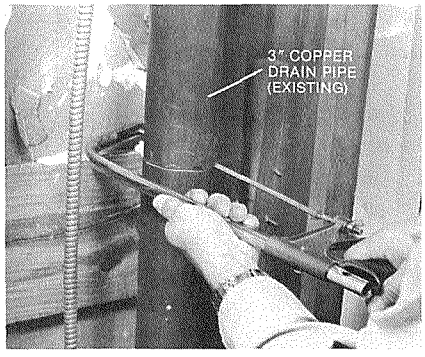
Dry-assemble the waste-line run (see plans). When the fit is correct, weld the joints with solvent cement. In our installation, the trap and cleanout and all waste piping (except the standpipe) is hidden behind a hardboard access panel. Cut a notch in the panel at the back so the standpipe and hoses can pass through.

The electrical specifications for the White-Westinghouse units which we chose call for separate circuits. The washer operates on 120-v., 60-Hz a.c., fused with a 15-amp. delayed action fuse or circuit breaker. The dryer is dual-rated for a 120/240- or 120/208-v., three-wire, 60-Hz circuit with a 30-amp. capacity. Ground both circuits according to local electrical codes. Install the outlets on the wall behind units.

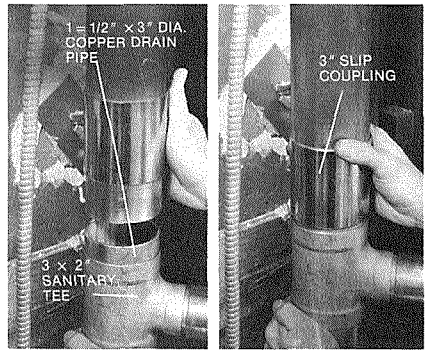
Putting the washer upstairs posed a special problem. If there should ever be an overflow, water damage to walls and ceilings could run into hundreds of dollars. As a precaution, we installed a drain pan.

First drill a 1-in.-dia. hole in the floor, a few inches from the exterior wall. Use hanger wire to check for obstructions such as joists or pipes that might interfere with cutting a hole for the drain. Relocate the hole if necessary. Then use a sabre saw or electric hacksaw (available at rental

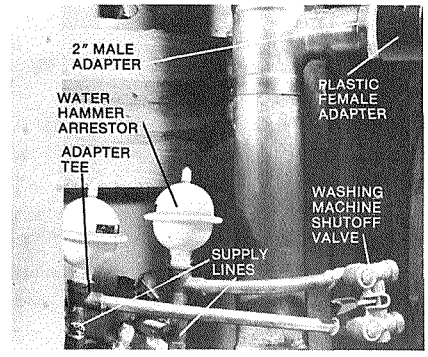
Tapping into existing bathroom plumbing



TO TAP into waste line, cut out section a few inches longer than the sanitary tee to be installed.



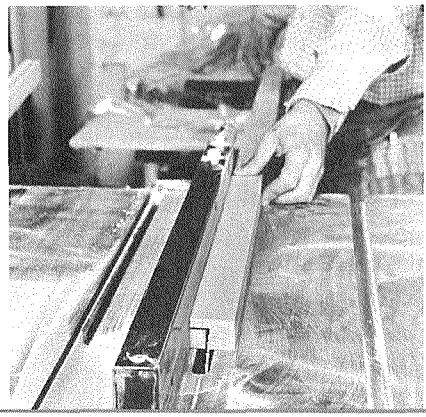
JOIN TEE to waste pipe by sliding slip coupling over short pipe section. Coupling must be installed before tee.

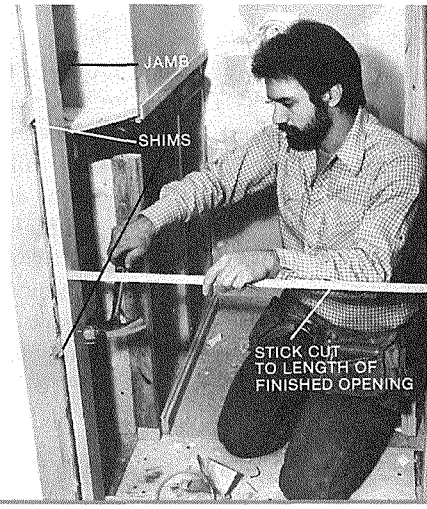


FLEXIBLE copper tubing was used to join existing lines to the washer shutoff. Washer hoses connect to valve.

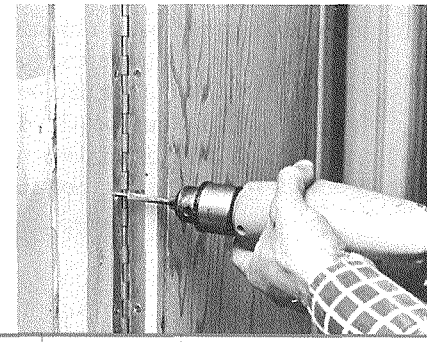
Building and hanging double doors

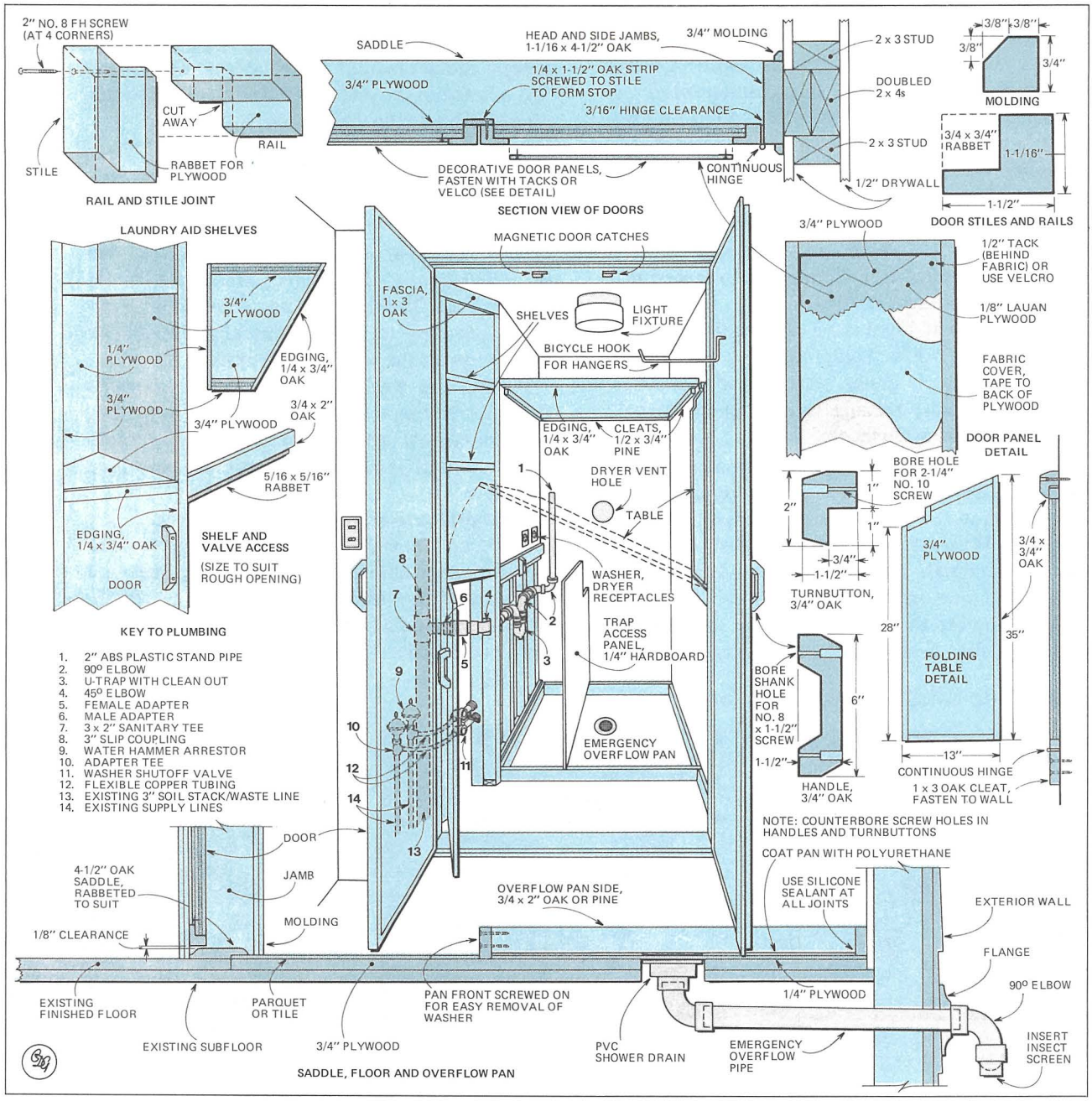
EASIEST WAY to cut rabbet for door frame is with two passes on table saw. Check depths and fence setting first.





USE PLUMB bob to install first jamb; shim as necessary. Cut stick to width and use to test for parallel while shimming second jamb (left). Drill and a screwdriving bit (above) save time when fastening continuous hinge to jamb.





shops) to cut a hole through ¾-in. plywood base and subflooring to allow clearance for drain. Cut a matching hole for the polyvinylchloride (PVC) shower drain in the ¼-in. plywood pan bottom. To make the drain grid cap fit flush to the plywood surface, use a router with a mortising bit to rabbet the circumference about ⅛ in. deep. Secure the drain to the pan bottom, using the gasket and locking nut provided and install the 90° elbow so it is turned perpendicular to the exterior wall. Install the pan bottom.

Next, cut a hole in the exterior wall. To insure that the drain pipe and the elbow drain fitting line up, measure carefully from a point common to both the outside and inside wall surfaces.

You will have to install the drain pipe blind. Sand the end of the pipe smooth for an easy slip fit and make a few dry runs until you are familiar with feeling the pipe into the fitting. Apply a generous amount of solvent to the pipe end, locate the elbow and insert. Hold the pipe in place for a minute while the cement sets.

IN ABOUT 10 months' worth of doing-it-himself on weekends and occasional weekday evenings, this homeowner transformed an attic into multi-use space. Cabinets at either end of sofa can be used for record albums, bar equipment or a small refrigerator. Area around the stair landing (left) serves as a library/gallery.

From attic to family room

With some careful planning this homeowner turned a cramped, makeshift attic studio into a spacious room used by the entire family

■ AN ATTIC is not generally thought of as a spacious, airy, abundantly lit, well-organized room, but Don Mannes, with design help from architect Ira Grandberg, has succeeded in creating one. The primary reason for the remodeling was to provide in-house office space. Don, an artist, required a drawing board and lots of counter and storage space for art supplies. His wife, Barbara, a schoolteacher, also needed a lot of desk area, plus plenty of room for files.

The room is so well-organized and pleasant to relax in, that by adding a prefab fireplace, it also serves as a family room and place for parties. It can even be used as a guest room. A built-in sofa with trundle bed, which pulls out from behind the wall, makes the transformation quick and easy.

Originally, the attic was chopped up with small closets and unnecessary partitions. Natural light came only from a pair of double-hung windows. The stairwell was narrow and a shaft that ran up its center to the ceiling obstructed light from the only other window on the floor.

The first remodeling step was to demolish the unwanted partitions. Then old windows were replaced with larger units. Removal of the central stairwell shaft walls, brought light from the previously obstructed window to the gallery/library area.

The key, however, to making the most of the space, was built-in furniture. The built-in sofa/bed and recessed wall boxes made use of behind-the-wall space which under normal circumstances is difficult to utilize.

The aim was to make use of behind the wall space for bedding only used occasionally. Begin by framing the rough openings for the wall recesses and trundle. Construct the bed frame as

shown in plans, sizing it to suit your needs.

The sofa is framed with 2 x 4s and skinned with paneling. Cabinets flanking the sofa are of plywood over 1 x 2 cleat framing.

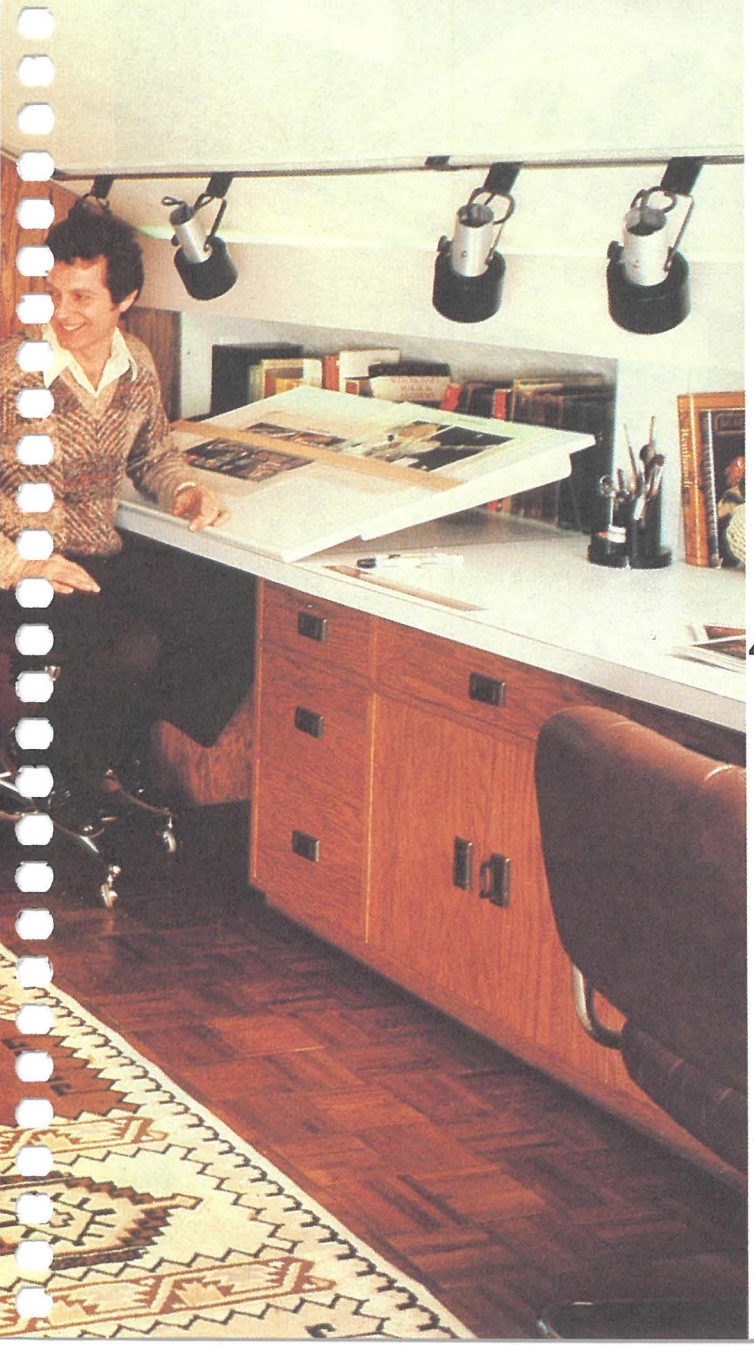
Recessed wall boxes above the sofa can be preassembled prior to installation. Glue and nails will assure strong joints. Secure these units to the rafters above and studs at ends with finishing nails.

1

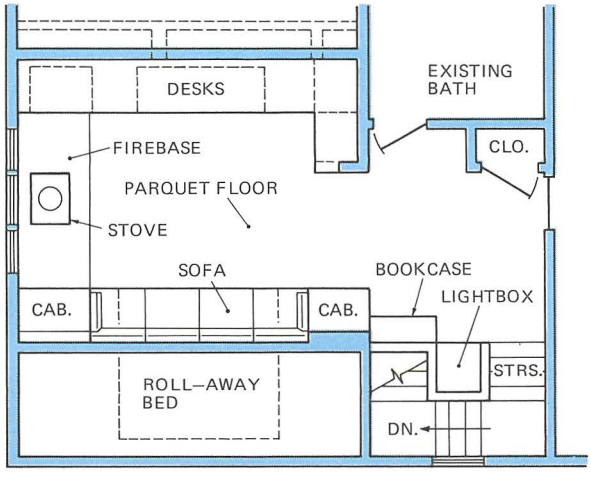
2

1 Prior to remodeling attic space served as a combination storage room and den.
2 The final product is a room for the whole family to enjoy.
3 Large, well-lit work surfaces with recessed wall storage and cabinets below provide couple with enough elbow room for independent, varied pursuits.
4 A couch with a convenient roll-out trundle bed becomes a cozy resting place for overnight guests.

3

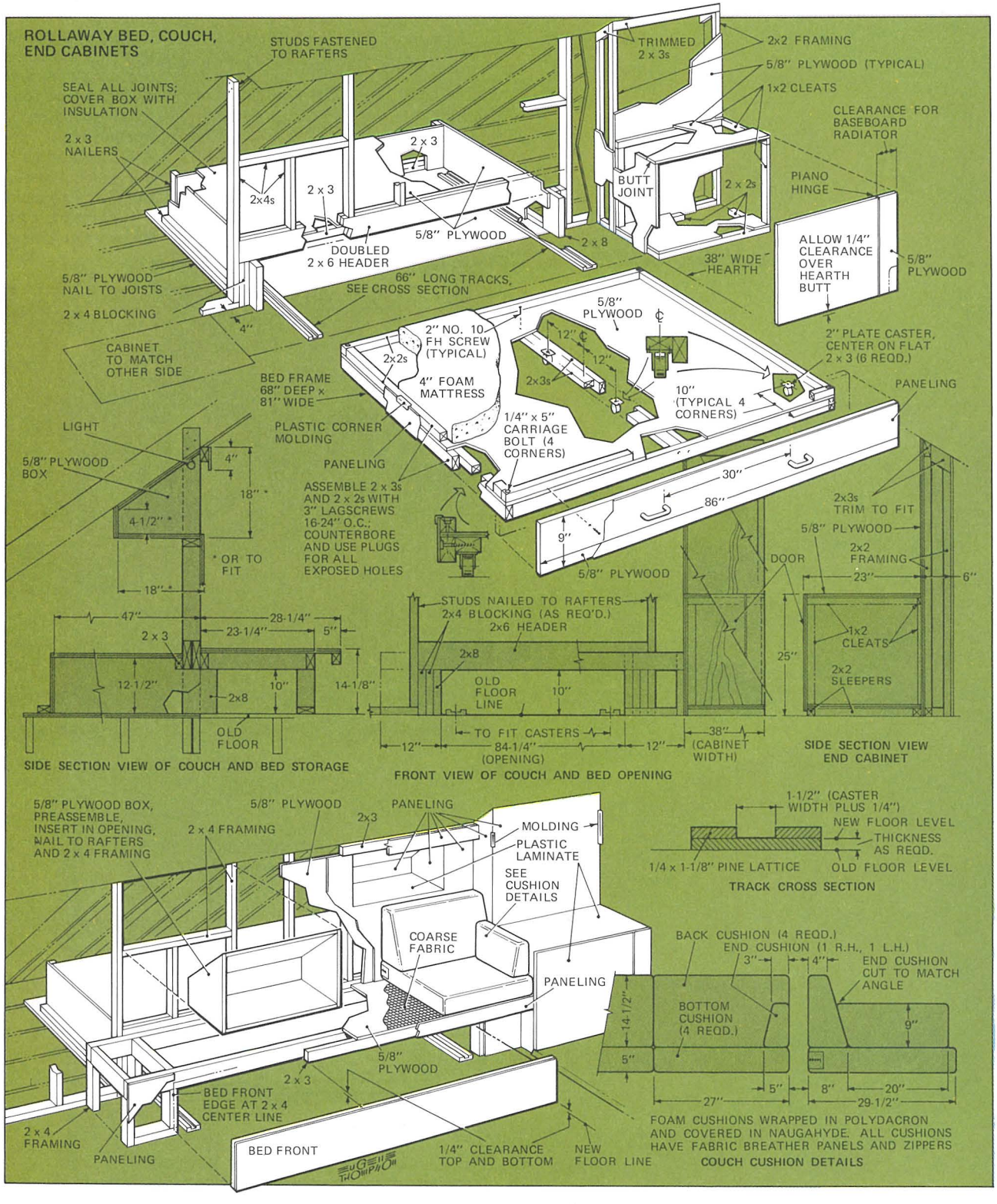


4



Before you build the desk, cut and frame the rough opening for the shelf recesses. If you're not sure whether the attic knee wall is a bearing wall, have an engineer decide for you. If it is, adequate headers must be installed over all openings.

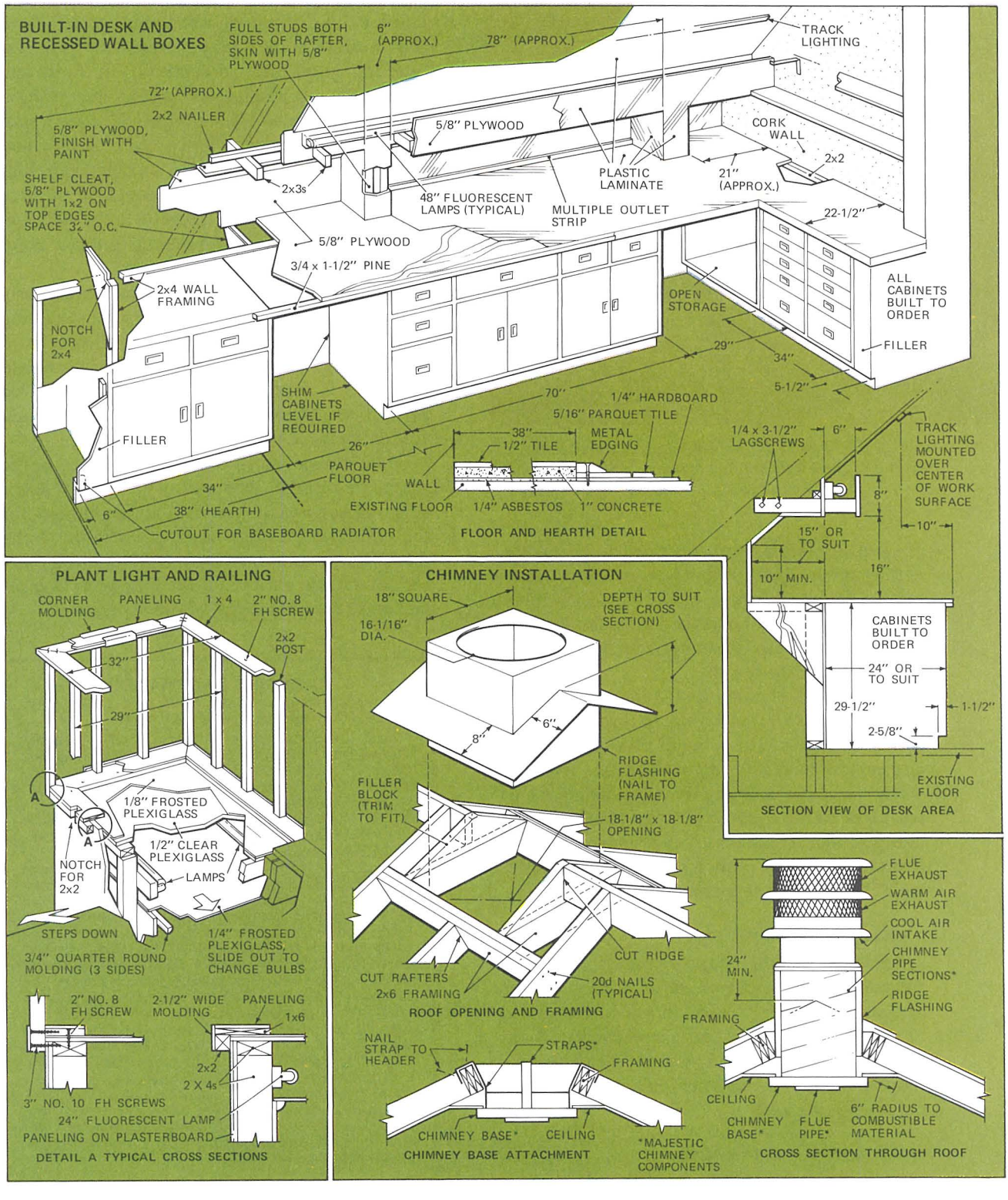
Next, construct the cantilevered fluorescent-light-fixture supports by fastening 2 x 4s with lagscrews to the rafters. At this time, you should have the wiring installed for all outlets and light fixtures.

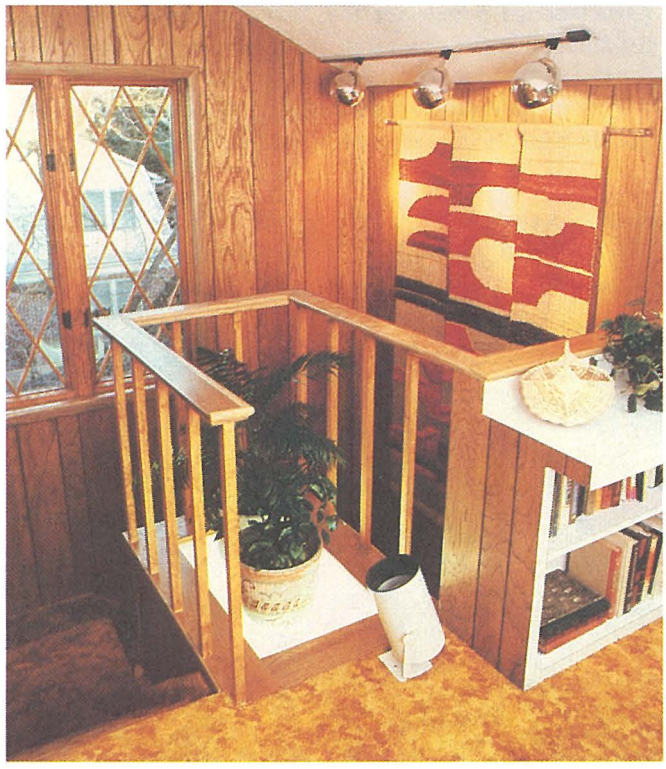


You can buy cabinets ready-made, have them custom-built or make them yourself. Screw cabinets to wall studs after they have been shimmed at wall and floor for level and plumb.

Once the cabinets are rigid, cut the plywood or particleboard panels for the desk top, notching for studs if necessary. Glue and nail a pine strip for the front edge to each panel.

Plastic laminate can be installed after the top panels have been fastened to cabinets, but it's





AN INGENIOUS in-the-floor fluorescent plant lamp, installed in shaft between the stairs serves as night light.

easier to apply it beforehand. Start at front edges, cutting the laminate strips ⅛-in. oversize so they can be trimmed with a flush-trimming carbide router cutter. Then bond the laminate to the top surface, again cutting the piece slightly oversize and trimming afterward.

Fasten the laminated top to the cabinets with corner braces or by screwing up through cabinet corner brackets. Then build plywood dividers and enclose back and top of the recess with plywood. To make skinning recess easier, screw recess back to the desktop prior to sliding the top into position. Apply plastic laminate to dividers. Paint top and back of recesses. Install a multiple-outlet strip and light fixtures.

recessed floor/ceiling lamp

Removal of the stairway shaft partitions created a perfect spot for a through-the-floor fluorescent light. This provides subtle underlighting for showing off plants and a night light for the stairs and room below. The ½-in. plexiglass will support 150 lbs. Access to bulbs is through a sliding plexiglass panel.

prefab fireplace slate hearth

Since the fireplace unit we selected has a 7-in. clearance from the floor, noncombustible floor material beneath and around it was a must. We used slate tiles set in a 1-in. bed of mortar over a ¼-in. sheet of asbestos millboard. To build such a hearth, nail asbestos millboard and a layer of wire mesh to the floor. Use 2 x 2s to build form for mortar at sides. Experiment with tile patterns and make a dry run before mixing mortar. Then shovel mixture of 1 part mortar mix to 1 part sand mix into form to a depth of 1 in. Level and smooth the mix and tap slate lightly into position using a hammer and wood block. We used a simple brickwork pattern with 5/16-in. spaces and worked from front to back, starting with full-width tiles. The mortar mix should be thick to keep tiles from settling too low. If they do, put some mix under them and retamp in place. Point space between tile using joint filler.

To cut tiles for fitting in the last rows, use a portable circular saw with a masonry cutting blade. Prepare a simple jig to hold two sides of the tile snug. Lay a piece of plywood on top to hold tiles in place and cut along exposed area about three quarters through for a clean break. Cut on the exposed side of tile.

Since we wanted to center the fireplace in the room, the chimney passes through the roof at the ridge. See framing details and the design for the custom-built ridge-flashing assembly in the plans. At the roof opening, a triple wall pipe circulates outside air around the inner flue to insulate and prevent ignition of nearby rafters.

SHOPPING INFORMATION

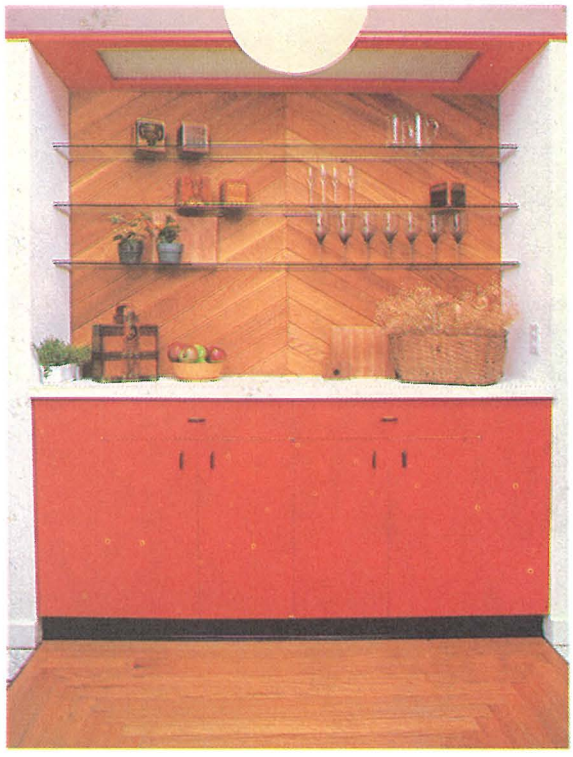
For buying information or the nearest dealer, write directly to the manufacturers listed below.

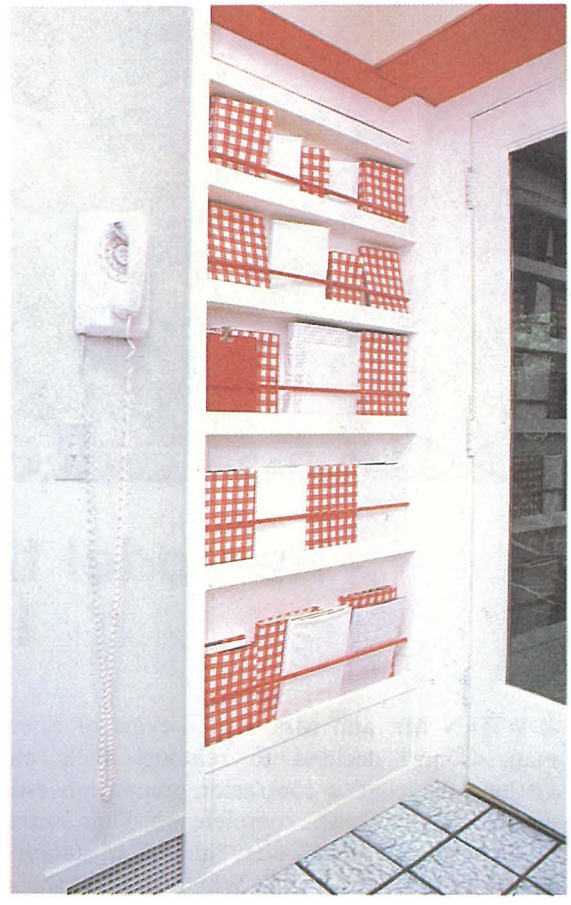
Carpet, Delicious style in Crown gold color, Bigelow-Sanford, Inc., Box 3089, Greenville, SC 29602; **Chairs,** Crown Discount Corp., 3128 Queens Blvd., Long Island City, NY 11101; **Counter laminate,** White, WilsonArt, Ralph Wilson Plastics Co., 600 General Bruce Dr., Temple, TX 76501; **Fireplace,** Venus model, The Majestic Co., 245 Erie St., Huntington, IN 46750; **Sofa fabric,** Saddleback Naugahyde in Nutmeg, Uniroyal Inc., 1230 Avenue of the Americas, New York, NY 10020; **Parquet flooring,** Cumberland II oak parquet in chestnut brown, E.L. Bruce Co., Inc., 4255 LBJ Freeway, Dallas, TX 75234; **Lighting,** Continental and Universal style track lights, wall-wash floods and regressed-eye recessed lights and Vienti series spheres, Halo Lighting, 400 Busse Rd., Elk Grove Village, IL 60007; **Textured paint** on ceiling, Easy-Tex, Gold Bond Building Products, Div. National Gypsum Co., 325 Delaware Ave., Buffalo, NY 14202; **Wood paneling,** Capri Elm, Weyerhaeuser Co., Tacoma, WA 98401; **Slate hearth,** A. Dally & Sons Corp., Box 27, Pen Argyl, PA 18072; **Windows,** Carclad casements, Caradco Window & Door Div., Box 920, Rantoul, IL 61066; **Accessories: Afghan kit,** Bucilla Co. 30-20 Thomson Ave., Long Island City, NY 11101; **Desk accessories,** Bouton's, Spring Valley, NY 10965; **rug,** Victor Henshel, Inc., 1061 Second Ave., New York, NY 10022; **Wallhanging/baskets,** Judy Deming of Loomworks, New City, NY 10956.

Remodel the kitchen yourself—including the cabinets

■ WHEN Mr. and Mrs. Paul Levine of Sherman, Conn., decided to remodel their old kitchen, they had a contractor prepare an estimate of the cost for the complete job. Their initial reaction to the price was "almost a state of shock" according to Paul. "What I thought was a rip-off turned out to be the high cost of materials and labor," he added.

Since he felt he could build the kitchen for a small fraction of the contractor's price, he worked up his own estimate of the cost for all the materials, as well as allowing for some profes-





AS SHOWN ABOVE, the existing closet became a contemporary "hutch" with a recessed light, glass shelves and cabinets. The recessed cedar ceiling pattern (above right) is repeated in the hutch and on the cabinets. The cookbook rack (below right), built into an otherwise wasted corner, keeps recipes handy.

sional help. To this he added "the cost of jobs I could not do myself and would have to farm out." This figure turned out to be less than half the original bill.

Unless you are well versed in cabinet construction and kitchen layout, it's a good idea to consult with a professional designer before you start your remodeling project. Since even a do-it-yourself kitchen involves considerable cash outlay, it makes no sense to put in the effort and end up with a product that doesn't function properly or isn't appealing.

The work in Levine's kitchen began with the removal of all the old cabinets, existing plumbing fixtures and the old plasterboard. Though it's messy, removal of the plasterboard gives ready access to wiring and permits the addition of insulation to outside walls. Old doors and single-pane windows were removed.

With all the demolition complete and debris removed, the outside wall was immediately closed in to the weather by framing openings and installing new windows and doors.

Framing for special features like the hutch alcove and the sloped ceiling with soffit came next. At this time, all of the electrical wiring, rough plumbing and insulation was done. An outside vent for the stove was also installed. Plasterboard went on last, was taped and allowed to dry thoroughly before priming and painting.

Floor tiles were installed using mastic and epoxy grouting. This job was farmed out. If you lay the tile yourself, you can save even more money. The peripheral floor area, under the counters, was brought up to level with ½-in. plywood.

The oak floor inset was installed with a ⅜-in., cork-filled expansion gap at the edges. A 3-in. portable belt sander was adequate for sanding this small area. A finishing sander brought the floor to a smooth surface before the floor was varnished.

Note: If there is a difference in thickness between the wood floor and the tile floor, you will have to compensate for it with a layer of plywood before you begin.

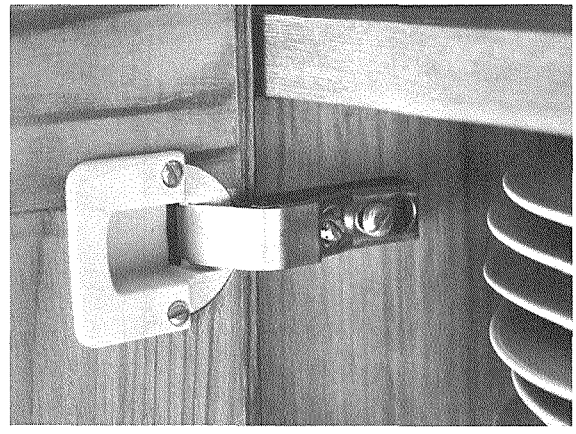
building the lower cabinets

Begin the base cabinets by determining the overall cabinet dimensions and then cutting parts to suit. Glue the back panel and grooved rails together first. Then cut the top rails and a cabinet bottom of the same length. Edge the ¾-in. plywood bottom with solid mahogany strips to protect the plywood edges and improve the appearance. Make the cabinet sides from ¾-in. plywood next, routing for the back, bottom and rails as shown in the drawing on page 66.

When you are assembling the cabinet, it will square itself if the pieces have been cut correctly. But, it is advisable to check for square while gluing. With all cabinets in place, shim so that the tops form one continuous level line against the walls. Secure the units to the walls with hefty, long screws through the rails and into the studs. Fasten the units together with screws through the sides.

The countertop was made in four sections. Laminate the front edges first, then the top. It's a good idea to also laminate the underside to reduce the chance of warping damage.

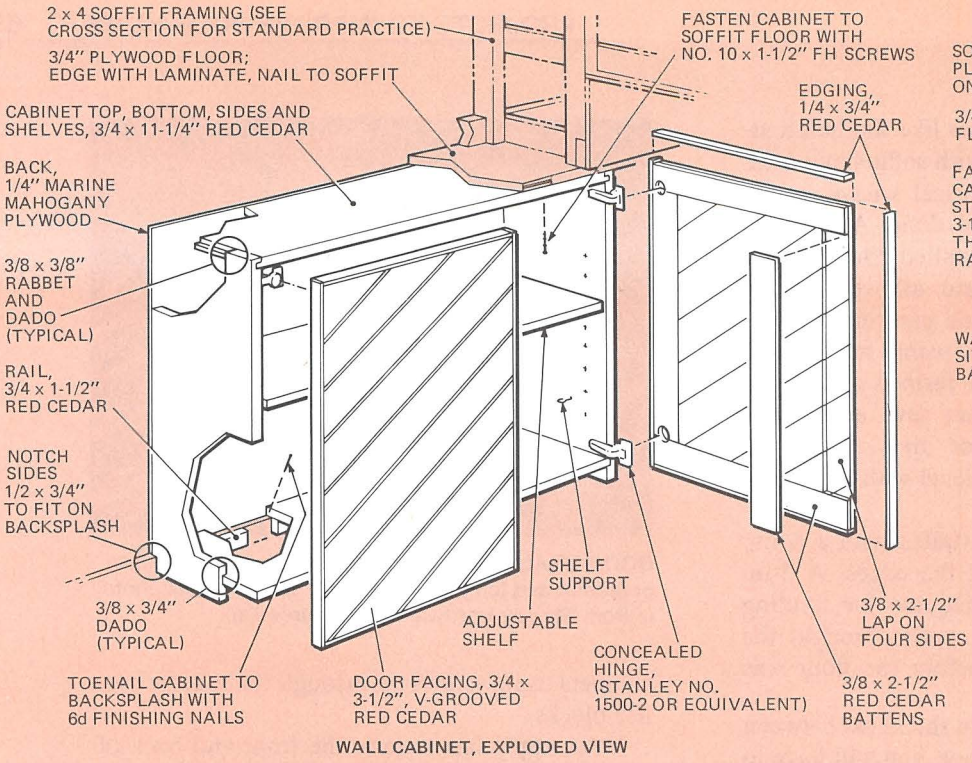
Use contact cement intended for high-pressure laminates. Follow the manufacturer's instructions carefully. These adhesives are very harmful to breathe and are very highly flammable. Work in a well-ventilated room. Install the sections using Tite-Joint fasteners to pull the seams together. Then fasten the countertop to the lower cabinets using screws up through the rails or corner blocks.



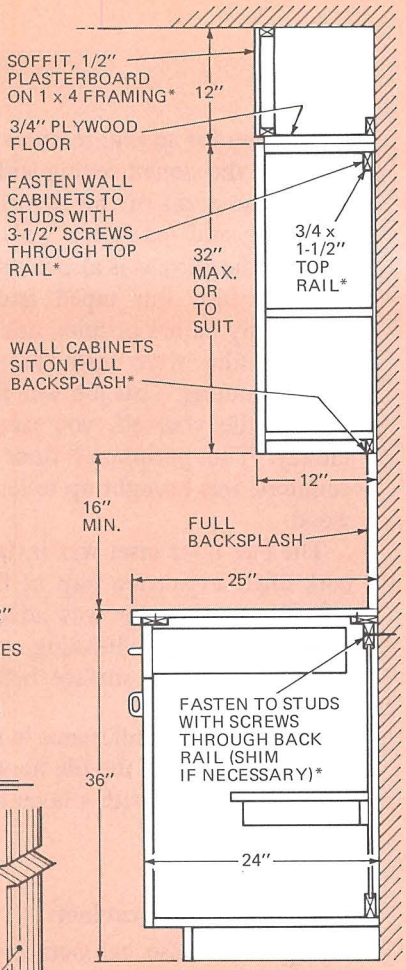
GOOD-QUALITY drawer hinges are essential for easy operation and long life. The hinge shown in this photo is from Stanley Hardware (see source list).

Next, apply laminate to the front and back of the backsplash and to all exposed vertical edges. Set the bottom of the backsplash in a bed of caulk and screw or toenail the top to the studs. To insure rigidity, you can also predrill and install

THE SLIDES shown here keep drawers moving quietly and easily. Flexible rubber drawer pulls prevent bumps and bruises when kids collide with them.

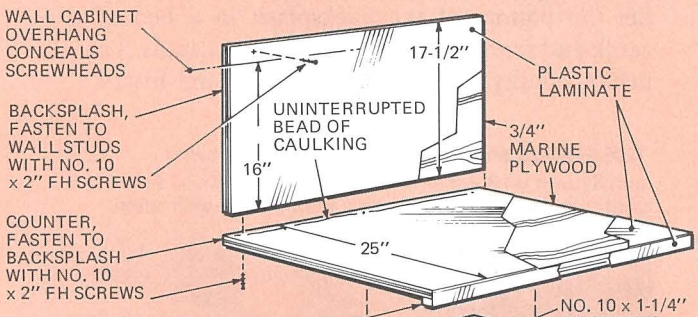

2 x 4 SOFFIT FRAMING (SEE CROSS SECTION FOR STANDARD PRACTICE)
3/4" PLYWOOD FLOOR; EDGE WITH LAMINATE, NAIL TO SOFFIT
CABINET TOP, BOTTOM, SIDES AND SHELVES, 3/4 x 11-1/4" RED CEDAR
BACK, 1/4" MARINE MAHOGANY PLYWOOD
3/8 x 3/8" RABBET AND DADO (TYPICAL)
RAIL, 3/4 x 1-1/2" RED CEDAR
NOTCH SIDES 1/2 x 3/4" TO FIT ON BACKSPLASH
3/8 x 3/4" DADO (TYPICAL)
TOENAIL CABINET TO BACKSPLASH WITH 6d FINISHING NAILS
DOOR FACING, 3/4 x 3-1/2", V-GROOVED RED CEDAR
ADJUSTABLE SHELF
SHELF SUPPORT
CONCEALED HINGE, (STANLEY NO. 1500-2 OR EQUIVALENT)
FASTEN CABINET TO SOFFIT FLOOR WITH NO. 10 x 1-1/2" FH SCREWS
EDGING, 1/4 x 3/4" RED CEDAR
3/8 x 2-1/2" LAP ON FOUR SIDES
3/8 x 2-1/2" RED CEDAR BATTENS

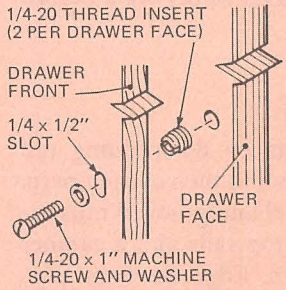
WALL CABINET, EXPLODED VIEW


SOFFIT, 1/2" PLASTERBOARD ON 1 x 4 FRAMING*
12"
3/4" PLYWOOD FLOOR
FASTEN WALL CABINETS TO STUDS WITH 3-1/2" SCREWS THROUGH TOP RAIL*
32" MAX. OR TO SUIT
3/4 x 1-1/2" TOP RAIL*
WALL CABINETS SIT ON FULL BACKSPLASH*
12"
16" MIN.
FULL BACKSPLASH
25"
FASTEN TO STUDS WITH SCREWS THROUGH BACK RAIL (SHIM IF NECESSARY)*
36"
24"

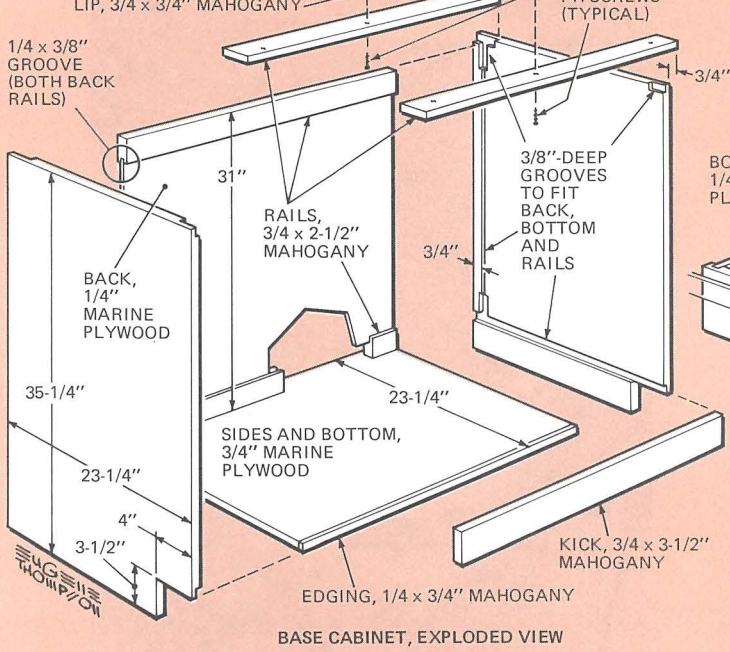
*STANDARD INSTALLATION PROCEDURES

TYPICAL CROSS SECTION

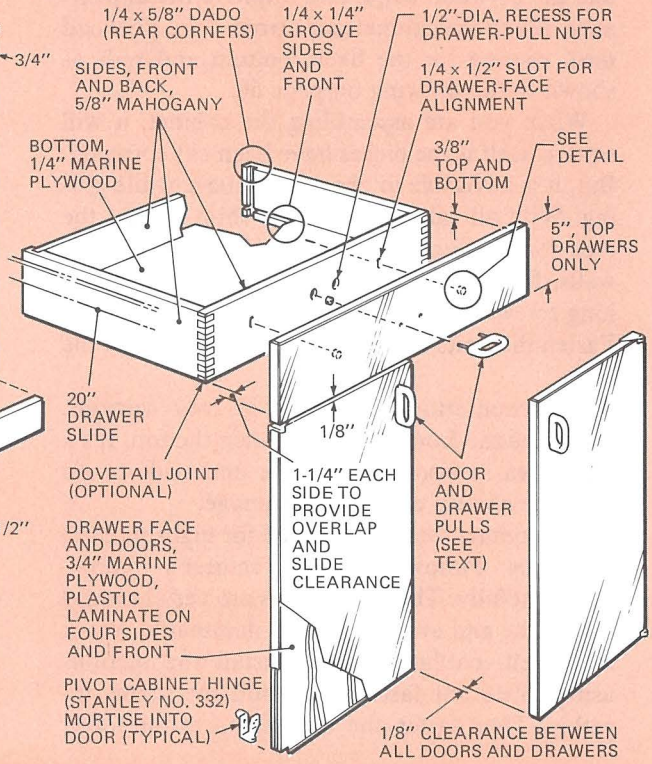

WALL CABINET OVERHANG CONCEALS SCREWHEADS
BACKSPLASH, FASTEN TO WALL STUDS WITH NO. 10 x 2" FH SCREWS
COUNTER, FASTEN TO BACKSPLASH WITH NO. 10 x 2" FH SCREWS
17-1/2"
UNINTERRUPTED BEAD OF CAULKING
16"
25"
PLASTIC LAMINATE
3/4" MARINE PLYWOOD
LIP, 3/4 x 3/4" MAHOGANY
NO. 10 x 1-1/4" FH SCREWS (TYPICAL)



DRAWER FACE MOUNTING DETAIL



BASE CABINET, EXPLODED VIEW


1/4 x 5/8" DADO (REAR CORNERS)
1/4 x 1/4" GROOVE SIDES AND FRONT
1/2"-DIA. RECESS FOR DRAWER-PULL NUTS
SIDES, FRONT AND BACK, 5/8" MAHOGANY
1/4 x 1/2" SLOT FOR DRAWER-FACE ALIGNMENT
BOTTOM, 1/4" MARINE PLYWOOD
3/8" TOP AND BOTTOM
SEE DETAIL
5", TOP DRAWERS ONLY
20" DRAWER SLIDE
1/8"
DOVETAIL JOINT (OPTIONAL)
1-1/4" EACH SIDE TO PROVIDE OVERLAP AND SLIDE CLEARANCE
DOOR AND DRAWER PULLS (SEE TEXT)
DRAWER FACE AND DOORS, 3/4" MARINE PLYWOOD, PLASTIC LAMINATE ON FOUR SIDES AND FRONT
PIVOT CABINET HINGE (STANLEY NO. 332) MORTISE INTO DOOR (TYPICAL)
1/8" CLEARANCE BETWEEN ALL DOORS AND DRAWERS

NOTE: STANDARD CABINET WIDTHS ARE 12, 15, 18, 24 AND 36"
STANDARD WALL CABINET HEIGHTS ARE 12, 15, 18 AND 30"
ASSEMBLE CABINETS WITH 6d FINISHING NAILS AND WATERPROOF GLUE

screws or nails up through the underside of the countertop and into the backsplash. Take care not to penetrate the exposed laminate surface with the screws or nails.

building the upper cabinets

The wall cabinets in this kitchen had to be fitted into place individually. This was done for the extra support provided by the backsplash and so there would be no gaps between the cabinet tops and soffit.

To build the upper cabinets, cut two sides and rout to receive the top and bottom, as shown in the drawing. Then drill the sides for shelf supports. Glue up the sides, top and bottom. Square and hold with clamps or countersunk finishing nails. Then lay the box flat, glue and tack the back in place.

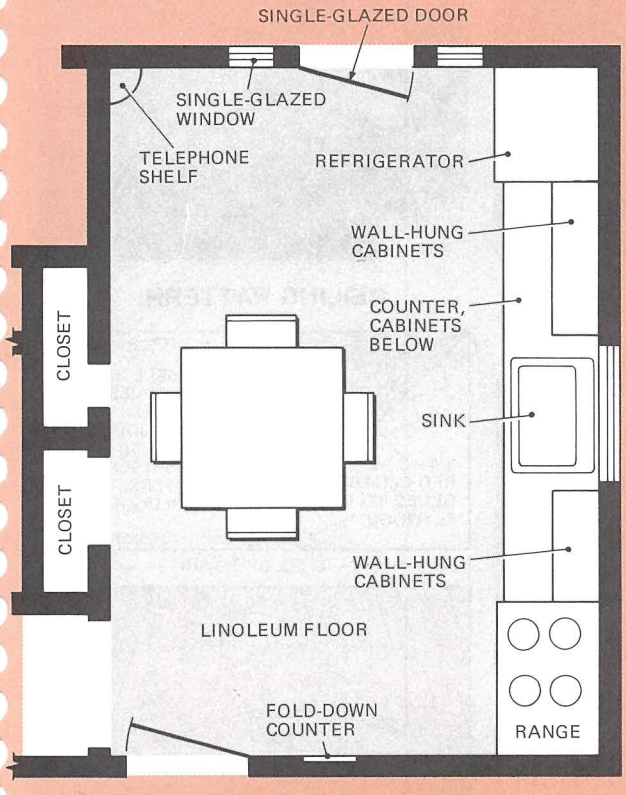
Mounting the cabinets to the wall is normally done through back rails and into wall studs. In this case, the soffit was framed with lumber heavy enough, and tied to existing studs with diagonal braces, so that the cabinets could be screwed into the soffit floor. In addition, the wall cabinets are supported by the backsplash and fastening with finishing nails driven through the bottoms. Install the doors on the upper and lower cabinets.

building the drawers

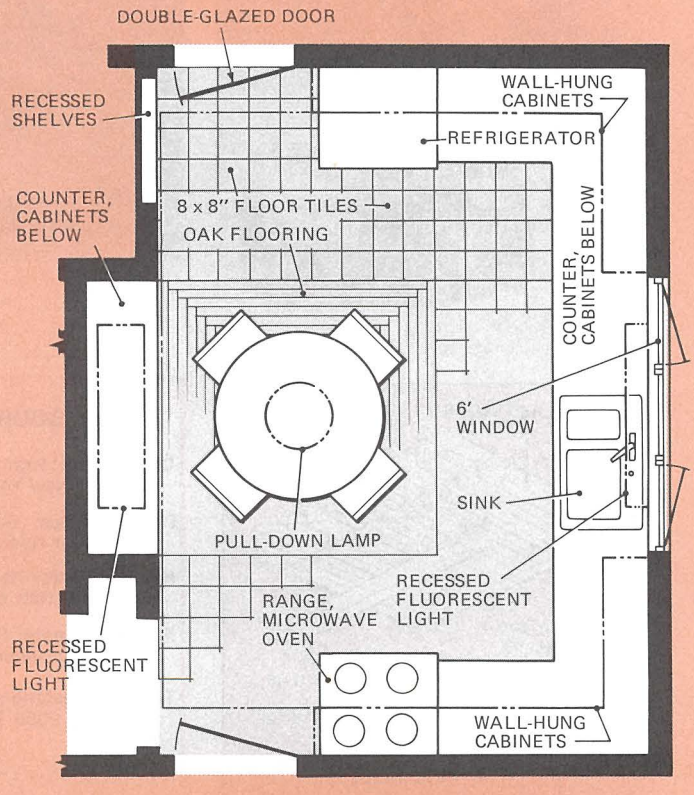
Make the drawers from ⅝-in. mahogany or other marine-quality plywood. Lapped front joints, nails and glue may be used in place of dovetails. Rout a ¼-in. groove for the bottom before gluing up. Then install it in the cabinet using good-quality drawer slides. Be sure to allow clearance for drawer slide hardware when determining drawer widths. The faces then receive plastic laminate on *all* surfaces and are mounted to the fronts with bolts (see drawer-face mounting detail on page 66).

The slots in the fronts permit the drawer faces to be shifted. That is so a close fit can be maintained, with no danger of the drawer fronts binding due to changes in temperature or humidity. If a drawer should drop out of alignment at one end, this detail makes it easy to square things up again.

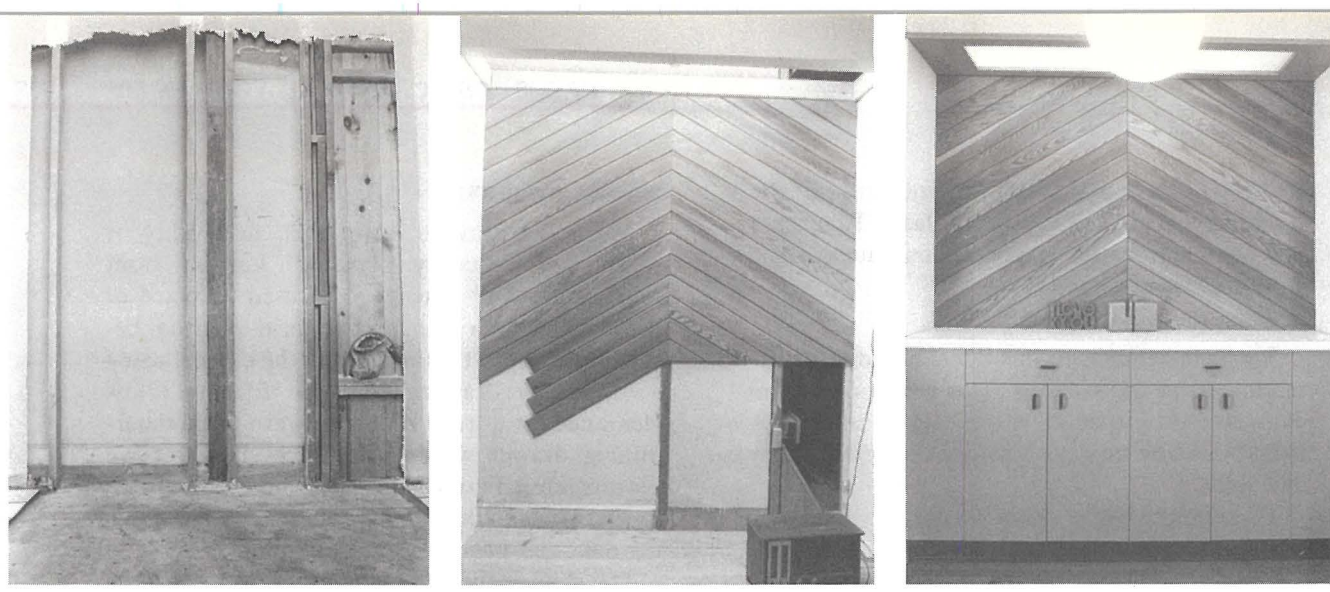
Use only quality hardware on all cabinet drawers and doors. This will ensure longer life and give your cabinets a professional appearance. Be sure to include child-proof catches on any cabinets which will contain cleaning supplies or other toxic substances. Sources for the hardware used here are given on page 68.



FLOOR PLAN / BEFORE



FLOOR PLAN / AFTER



THE OLD BROOM and pantry closet framing (left) was torn out to make way for the built-in hutch. New framing, light fixture and cedar boards (middle) went in first, followed by cabinets and plastic laminate countertop (right).

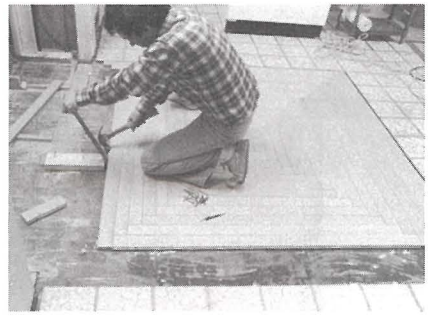
installing the ceiling piece

The ceiling piece is made in two halves, by gluing red cedar to ¼-in. plywood. Lay out the design on the plywood, cut the first miter, and glue the pieces in place. After the glue has dried, trim away the excess with a portable circular saw guided by a straight edge. Set the blade depth to ¾-in. before making the cut.

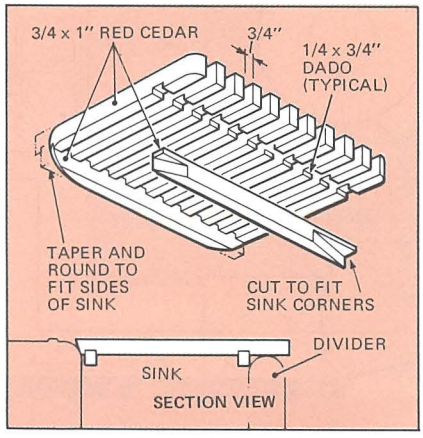
Apply the next pieces the same way, cutting the miter first and then gluing and trimming. The two halves may now be screwed to the ceiling joists using 2½-in. No. 10 wood screws. Counterbore, and plug for a finished appearance.

VEGETABLE washboard lets you rinse vegetables thoroughly and lifts out for removal. When fitting board, start slightly oversize and trim for neat fit.

TO ASSURE tight joints in strip flooring, cleats were nailed to the subfloor and a prybar was used to pull strips straight for nailing.



SLOPED CEILING with recess must be secured to existing studs and joists. Use lagscrews 16-in. o.c. to fasten top plates of recess framing to joists.



SOURCE LIST

Drawer pulls: Kraft Hardware Inc., 300 East 64th St., New York, NY 10021.

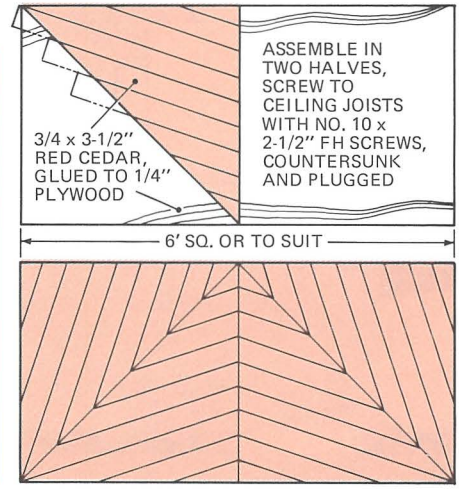
Drawer slides: Grant Hardware Co., 57 High, West Nyack, NY 10994. No. 527.

Hinges: Stanley Hardware, Div. of the Stanley Works, New Britain, CT 06050.

Plastic laminate: Formica Corp., 120 East 4th St., Cincinnati, OH 45232.

Tite-Joint fasteners: Albert Constantine and Son Inc., 2050 Eastchester Rd., Bronx, NY 10461

CEILING PATTERN


3/4 x 3-1/2" RED CEDAR, GLUED TO 1/4" PLYWOOD
ASSEMBLE IN TWO HALVES, SCREW TO CEILING JOISTS WITH NO. 10 x 2-1/2" FH SCREWS, COUNTERSUNK AND PLUGGED
6' SQ. OR TO SUIT

Plug-in electrical extenders

The installation of paneling often covers electrical outlets and switches. These extenders give you access without requiring any rewiring

AN UNFORTUNATE consequence of paneling over walls is that existing electrical outlets and switches are recessed from the new wall surface.

It is a time-consuming nuisance to move electric boxes flush with new paneling. Thus, I was particularly interested in trying three new products that obviate extensive electrical alterations: Light Switch Extender, Plug-In Outlet Extender and Frame Extender. All are a snap to install.

The Light Switch Extender, an easy snap-and-screw assembly with a two-screw attachment, is used where a space gap of 1 1/16-to 1⅛-in. is created between the outer surfaces of the old and new walls. Such gaps can be created by the thickness of planking or paneling installed over insulation, furring strips or wallboard.

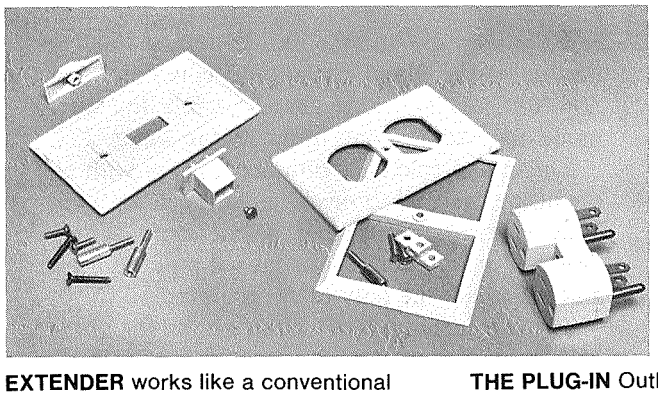
To install this device, replace the original plate screws with two male/female standoffs, snap the sliding button assembly through the cover plate and secure plate to standoffs with screws.

The Plug-In Outlet Extender is also designed to fill an 1 1/16- to 1⅛-in. gap. To install it, replace the center plate screw of the original outlet with a standoff. Then plug extender into original outlet.

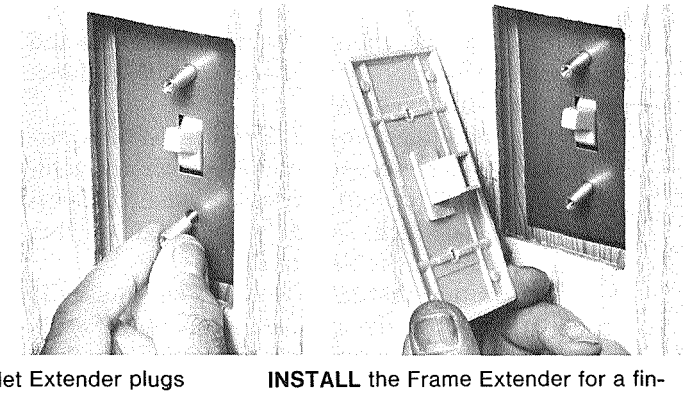
You could leave the cut-out opening in the new wall panel as is, but for a more professional look, finish it with a Frame Extender.

These items come in ivory or brown at housewares and hardware stores. Approximate retail prices are: Light Switch Extender, $3; Plug-In Outlet Extender, $4; Frame Extender, $2.50. They're from Miami International Marketing Inc., 777 Northeast 79th St., Miami, FL 33138.

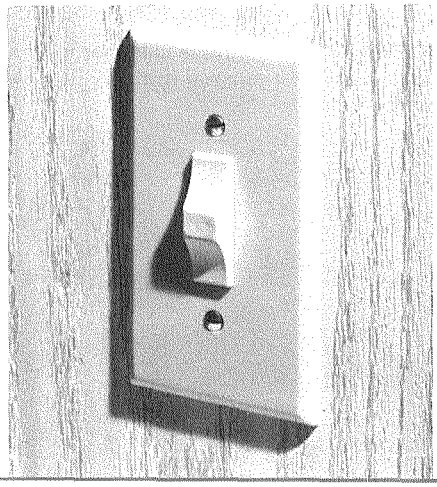
THREE ELECTRICAL extenders are (from left): Light Switch Extender, Frame Extender, Plug-In Outlet Extender.



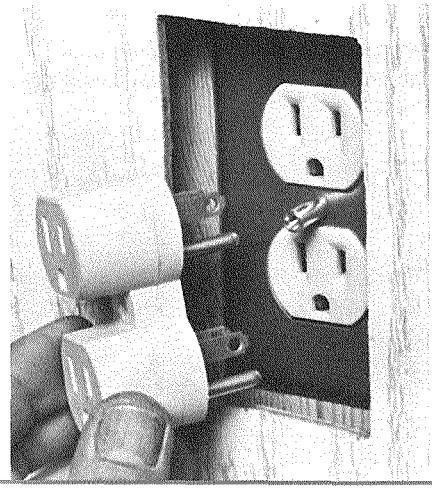
TO INSTALL the Light Switch Extender, screw on standoffs and fit new slide button over original switch.



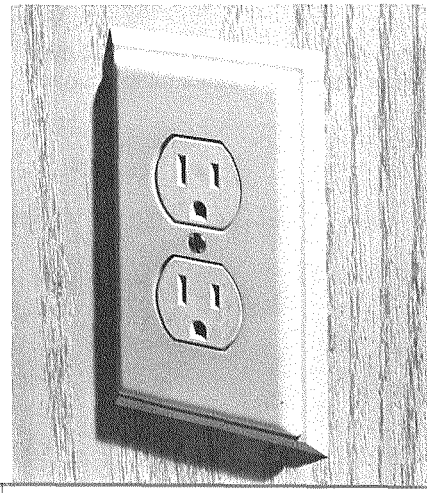
EXTENDER works like a conventional switch—you slide button up or down.

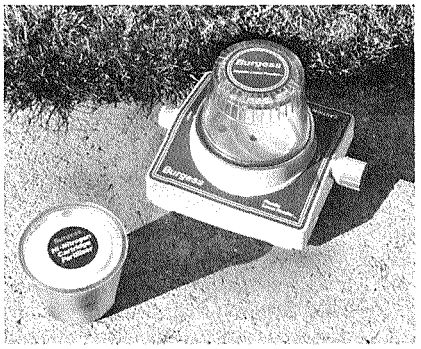


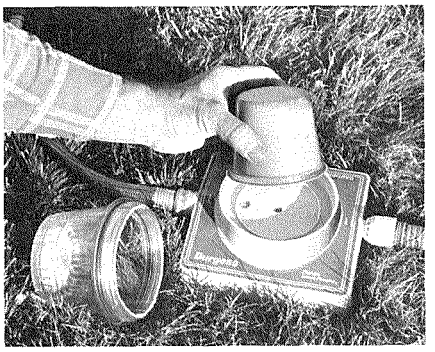
THE PLUG-IN Outlet Extender plugs into the existing outlet.



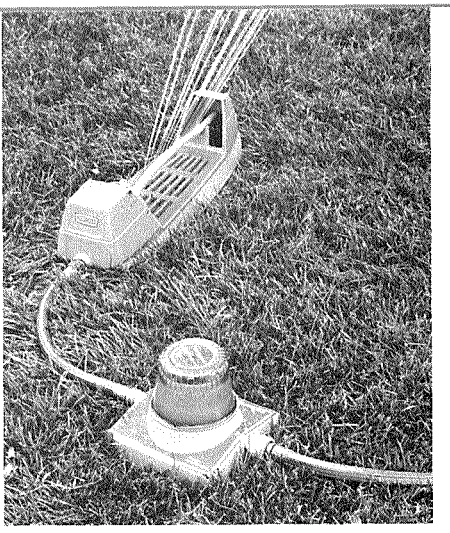
INSTALL the Frame Extender for a finished look. It fastens with a screw.







LOADING IS SIMPLE: Unscrew the transparent cover (above, left), peel the label off the bottom of the cartridge, insert the cartridge in the feeder (above, right) and replace cover. Turn water on to feed and water the lawn.



LAWN FEEDER has no moving parts. An 18-in. length of hose, to couple feeder to sprinkler, is included.

Automatic lawn feeder

■ MY LAWN used to show a brownish tinge, a common symptom of over- or under-fertilizing, due to erratic spreading or miscalculations in measuring the fertilizer. I replaced the brown with green by using a Burgess Fluidic Feeder, a unit that accurately fertilizes the lawn at the same time that it's watering it.

The chore couldn't be simpler. Attach the feeder between water hose and sprinkler and load it with a cartridge of concentrated soluble fertilizer. Water flowing through feeder dissolves fertilizer and distributes it evenly through sprinkler. A built-in diaphragm device prevents back flow into potable water.

The feeder, available at many hardware stores, costs about $30. The price includes six Hi Nitrogen cartridges. Each cartridge dissolves in about 15 minutes and fertilizes 1000 to 1500 sq. ft. of lawn. Refills come in two formulations: Hi Nitrogen and Basic Diet from Burgess Vibrocrafters Inc., Grayslake, IL 60030.

Clean water system

■ IF you're suspicious of harmful chemicals and disturbed by odors in your water, try this whole-house filtering system.

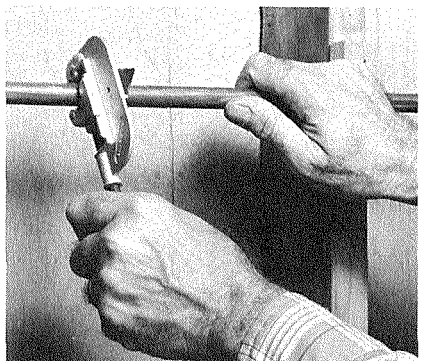
The unit utilizes an activated-carbon filter cartridge which removes potentially harmful chemicals. It also filters out particles as small as 5 microns (0.0002-inch) in size. Compared to other systems, this one is way up front.

The feature that makes the system unusually easy to install is the built-in control valve which has three positions: bypass, off and filter. This eliminates additional expensive plumbing. The bypass allows you to suspend filtering for lawn care, laundry use and the like, thereby extending the life of the filter. The shutoff cuts out water flow for easy cartridge change, while the filter mode activates the unit to purify the water.

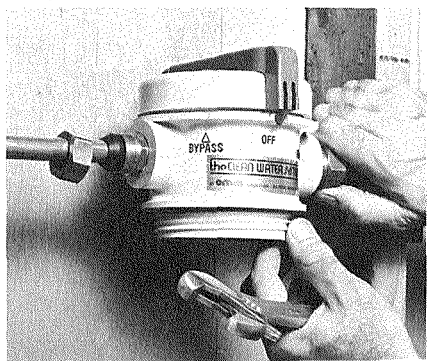
The unit is sold as a complete system with all the fittings needed for installation on either ½- or ¾-inch existing copper or plastic main supply line. For installation on galvanized pipe, a nipple and union are the only extras required.

The kit, including one filter, retails for about $50. Replacement cartridges cost about $5. From Omni Corp., Box 305, South Holland, IL 60473.

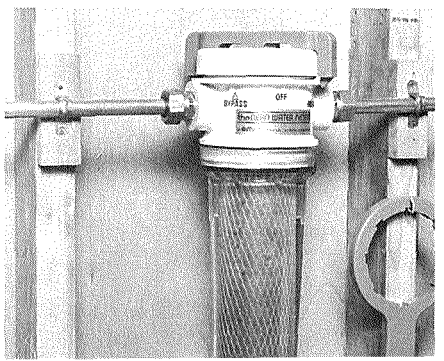
CUT A 6⅛-in.-long section out of the water supply line with a tubing cutter.



ENGAGE LOCKNUTS by hand; then tighten with a wrench to make seals watertight.



SCREW FILTER cartridge chamber to head. Hang filter removal wrench nearby.



Snap-together gutters and downspouts

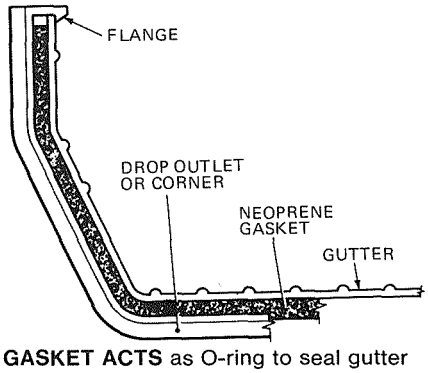
THE RAINGO VINYL gutter and downspout system has several features that recommend it for do-it-yourselfers. First, it's easy to install. The gutter sections snap together—no rivets or glues are required. Brackets that support the gutter and downspout sections are screwed into the fascia or corner trim with rustproof screws.

Second, the vinyl parts are durable. They will not dent, rust, crack, chip or show scratches. The vinyl is nonflammable, nonelectrolytic and unharmed by sun and salt, acids and alkalies. Ice, snow and standing water are claimed to be okay too.

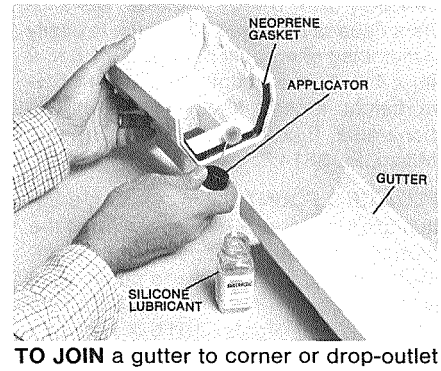
Although leaning a ladder against the gutters will bend them, the vinyl will not kink and will, in most cases, spring back into its original shape.

Third, the parts require no painting, but this may be done to match existing trim if desired. Latex enamels adhere exceptionally well to the vinyl. *Note:* If you choose to paint, do it on the ground before assembling the system. This is not only more convenient, but prevents paint from sealing joints at fittings. If you should decide to paint parts after the system is installed, disassemble it first. In both cases, keep paint off the gaskets and wait until the paint dries thoroughly.

The Raingo system is priced about the same as aluminum gutters and downspout systems. For more information, write to Genova Inc., 7034 East Court St., Davidson, MI 48423.

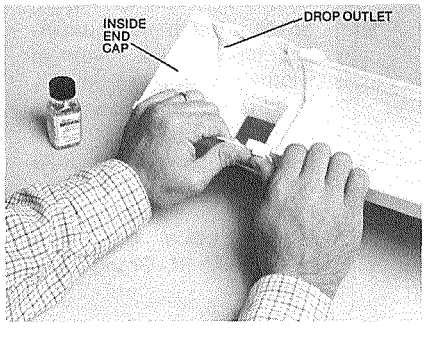


GASKET ACTS as O-ring to seal gutter system at joints, lets vinyl expand and contract as temperature changes.

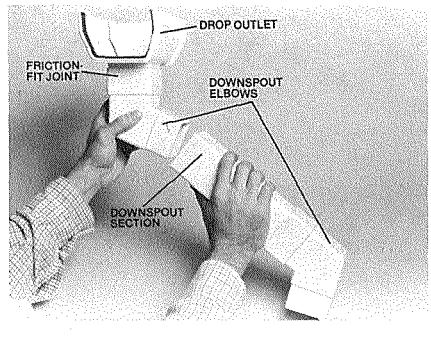


TO JOIN a gutter to corner or drop-outlet fittings, first spread silicone lubricant on gasket, using an applicator.

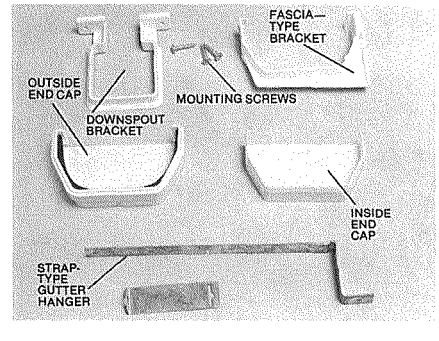
NEXT, HOOK the rear edge of gutter under back flange of fitting and snap front-gutter edge under front flange.



TO CREATE an offset beneath overhanging roof, use elbows and a downspout section cut with a hacksaw to suit run.

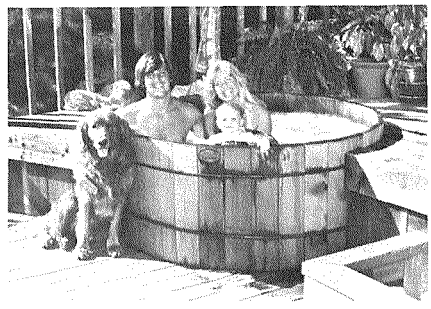


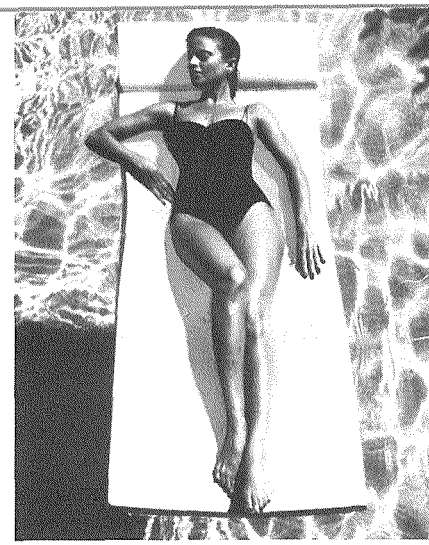
MISCELLANEOUS fittings round out the system. Gutters can be hung using galvanized straps or vinyl brackets.



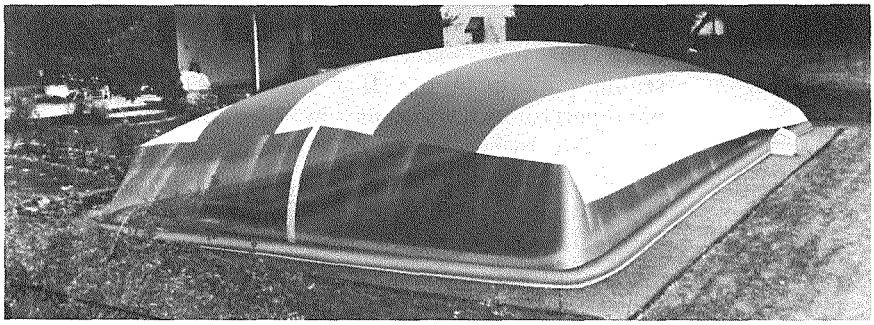
14 products to shape up your pool

THE HOT, bubbly water jets of this hot tub are just the thing to soothe tired muscles. The tub of redwood, cedar or mahogany staves is 4 ft. deep and ranges from 4 to 7 ft. in diameter. Prices from $1800 to just under $3250 include the tub, bench, pump, heater and four-jet whirlpooler. For more information on the tubs, write to the manufacturer at California Cooperage, Box E, San Luis Obispo, CA 93406.

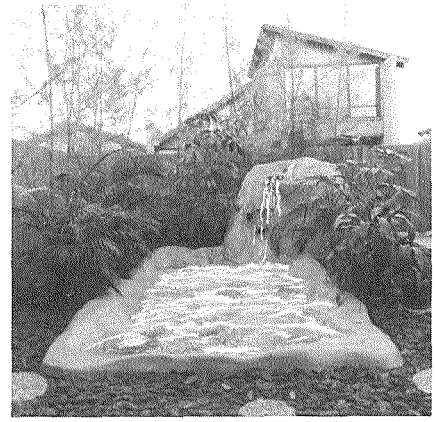




SOAK UP the sun while drifting luxuriously on this vinyl wrapped, closed-foam lounger. It's made the same way as a ship's lifesaving gear. You can use it also on a deck, pool-side paving or beneath a sleeping bag. Called Aqua Sun Lounger, it's about $160 from Poolmaster, 160 Jefferson Dr., Menlo Park, CA 94025.



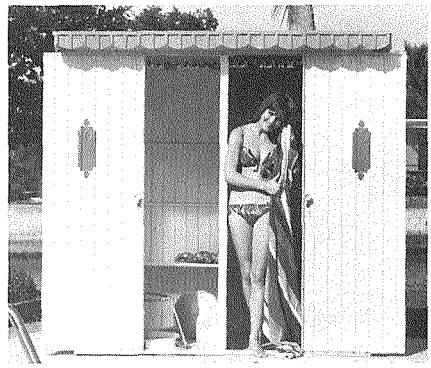
STRETCH THE SWIM season with an air-filled dome. Low-pressure blower (right of dome) operates only when there is a pressure drop within (as when someone opens zipped door). A 20x40-ft. dome fits an average (16x32-ft.) pool. With blower, dome runs about $1315 from SAC, 17 Cotters Lane, East Brunswick, NJ 08816.

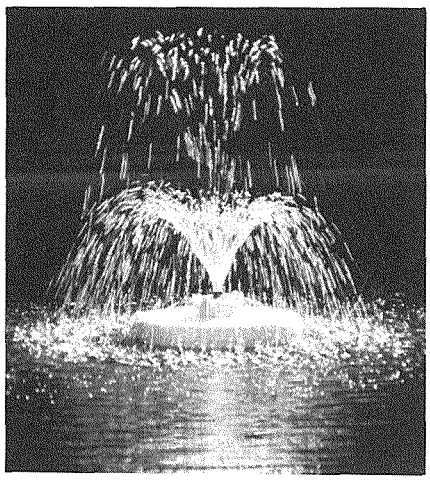


IT LOOKS like a natural stone spa and water cascade, but it's a fiberglass unit that drops into a shallow excavation by your pool. The 8 x 16 ft. model shown ($5500) includes a spa, waterfall, pump, filter and heater. An 8 x 9-ft. model is also made by Sun Country Distributing, 2224 West Desert Cove, Phoenix AZ 85029.

DRESS FOR A DIP by poolside. His-and-hers cabana of ribbed aluminum is easily assembled of prebuilt panels. It's 6 ft. 2 in. x 4 ft. 1 in. and adjusts to a 6-ft. 5½-in. height. It costs about $425 from Cabanarama, Box 945, Northwest Branch, Miami, FL 33147.

FLOATING FOUNTAIN is pleasing addition to an existing or new pool. Out of the carton, the fountain is operational in minutes. Just attach the hose to pump, pool return or garden hose. About $80 from Fountains For Pools, 1915-J Pathenia St., Northridge, CA 91324.





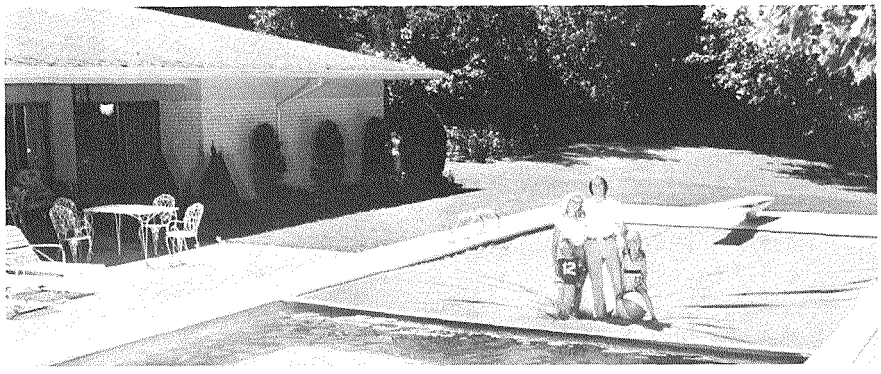
PICNIC under a redwood gazebo. The prefabricated lattice panels need no foundation and bolt together in less than a day. Assemble them with a hammer, screwdriver, wrench and measuring tape. They come in widths that range from 7¼ to 12½ ft.; prices are from about $900 to $1500. You can get more information on the gazebos by writing to the manufacturer at California Lattice Co., 616 North Eckhoff, Orange, CA 92668.

COMPUTERIZED pool/spa and solar heater system automatically controls pool operations. System (about $1100) has indoor control (inset); power center; solar, intake and return valve operators; two temperature sensors. Remote control shown at spa is optional. Compool Corp., 333 Fairchild Dr., Mountain View, CA 94043.

KEEP-N-HEET chemical stays on the pool water surface and inhibits evaporation and heat loss. It's odorless, tasteless, invisible and passes through the filter, according to its maker. A 32-oz. bottle costs $6 from Great Lakes Biochemical Co. Inc., 6120 West Douglas Ave., Milwaukee, WI 53218.

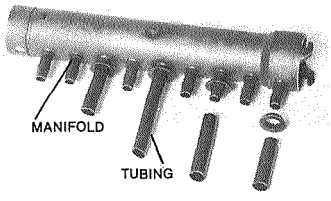
YOU CAN DRAIN your pool with the Water Wizard pump. Attach a 1-in.-dia. pipe or garden hose, set it in the water and plug it into a grounded 120-volt a.c. outlet. Little Giant Pump Co., 3810 North Tulsa St., Oklahoma City, OK 73112.

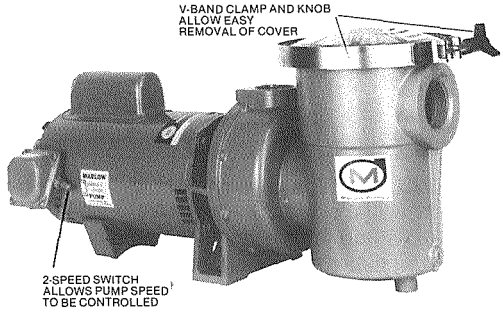
THE POOLSAVER is a motorized vinyl cover that slides into place on rollers in less than a minute, according to its maker. The cover seals tightly to save water and energy and act as a safety device. Prices for the Poolsaver, including installation, start at $2500 from Cover-Pools Inc., 117 West Fireclay Ave., Murray, UT 84107.



PHOTOZONE process water purifier sanitizes pool water by oxydizing pollutants and killing bacteria, thereby cutting chemical need by more than 50 percent. Several models from about $800 are made by Ionization International Inc., 1819 West Grand Ave., Chicago, IL 60622.

THIS SOLAR collector for pools comes in a custom do-it-yourself kit. Panels have upper and lower headers of 2-in.-dia. polypropylene, joined by polybutylene tubing cut to length. Kits with 600 sq. ft. of surface are under $2000 from Sunco Products, 243 South Indian Ave., Palm Springs, CA 92262.

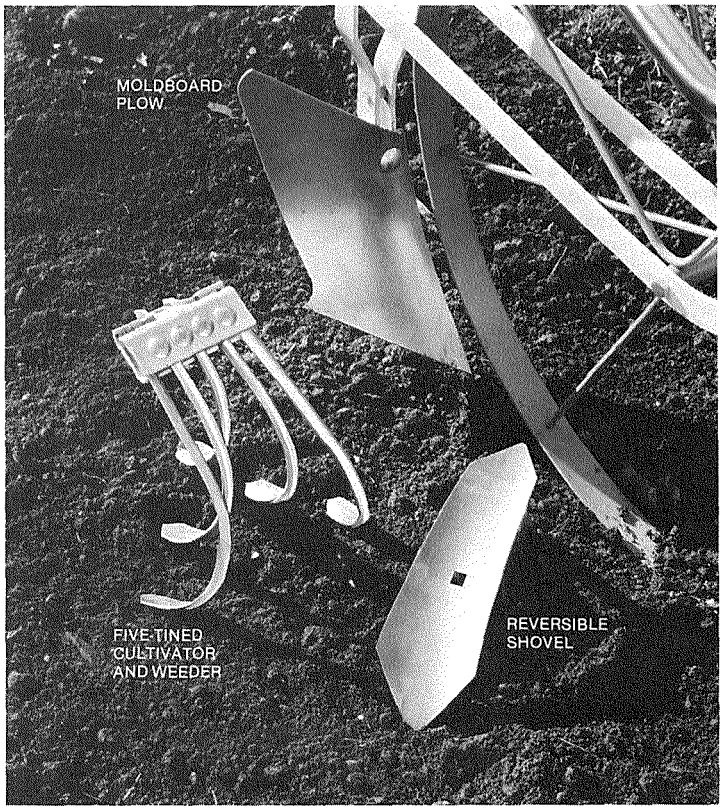


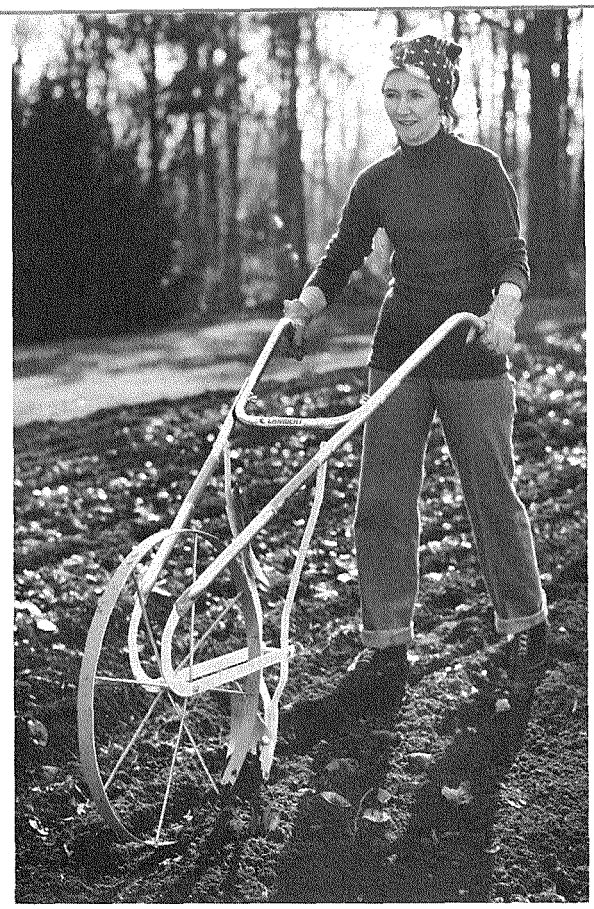


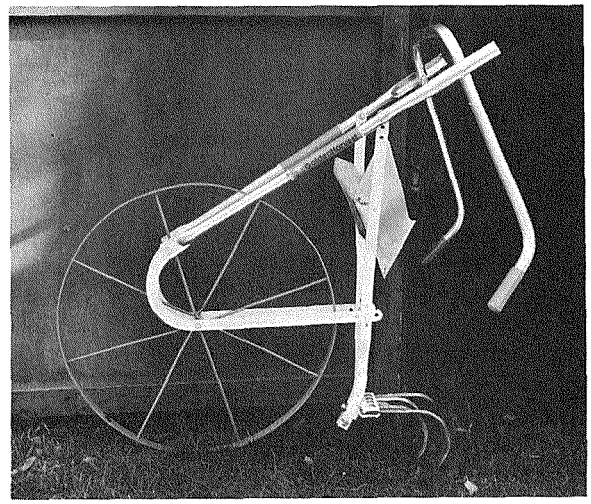
THE ENERGISAVER MarDur pump, designed for swimming pools, works at two speeds: high, during periods of heavy pool loads and low, during light-load periods and at night. It operates with no loss of clarity or chemical balance to the water, the company claims. Pump models range from ¾ to 2 hp. The model shown here is 1½ hp. The pumps sell from around $300 to about $500. You can get more information on these workhorses by writing the manufacturer at Marlow Pumps, Midland Park, NJ 07432.

10 power-them-yourself yard tools

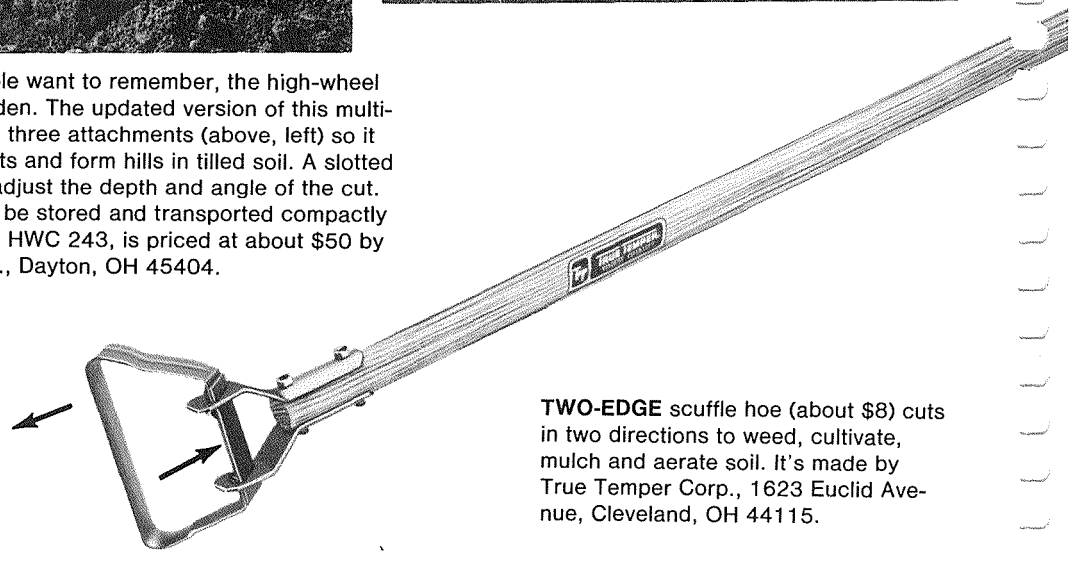
■ THE COST OF ENERGY these days is reason enough for many of us to have second thoughts before automatically turning on a gasoline- or electric-powered tool for a lawn or garden chore. Though there is little doubt that major manufacturers are making their power tools more efficient than ever, there are many instances when a hand tool—like the kind Grandpa used to use—will do the job as well. There's a bonus, too: You tone up your body as you shape up the yard.





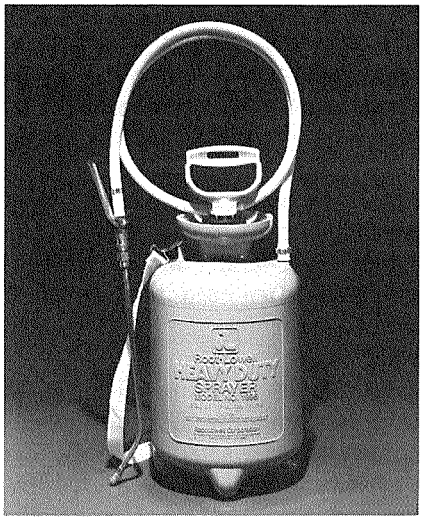


FOR MORE YEARS than most people want to remember, the high-wheel cultivator has helped out in the garden. The updated version of this multi-purpose tool (top, right) comes with three attachments (above, left) so it can furrow, cultivate, weed, cut roots and form hills in tilled soil. A slotted foot for plow attachments lets you adjust the depth and angle of the cut. Its handle folds so that the tool can be stored and transported compactly (above, right). The cultivator, model HWC 243, is priced at about $50 by the Lambert Corp., 519 Hunter Ave., Dayton, OH 45404.

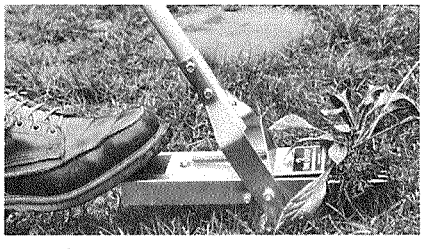


TWO-EDGE scuffle hoe (about $8) cuts in two directions to weed, cultivate, mulch and aerate soil. It's made by True Temper Corp., 1623 Euclid Avenue, Cleveland, OH 44115.

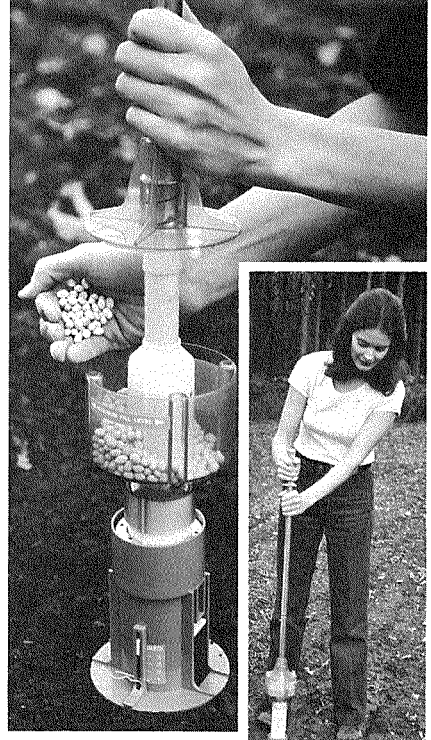
A SPECIAL CONTROL on this fertilizer spreader (about $60) can shut off the flow to its right side. When it's used next to a wall, fertilizer isn't wasted; flowers aren't damaged when you work near a garden. F.D. Kees Manufacturing Co., Box 905, Beatrice, NE 68310.

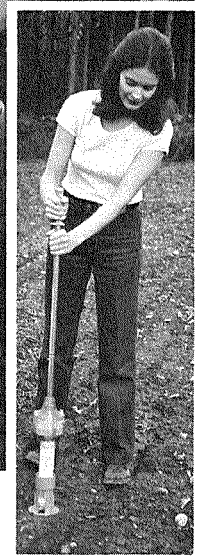


THIS HEAVY-DUTY, 2 gallon sprayer (about $38) is designed to withstand tough chemicals with minimum maintenance. Sprayer has a funnel top to reduce chemical spills and a metal striking plate to stop premature fatigue on pump can. Pump action allows tank-pressure buildup for continuous spraying. It's made by Root-Lowell Corp., Lowell, MI 49331.

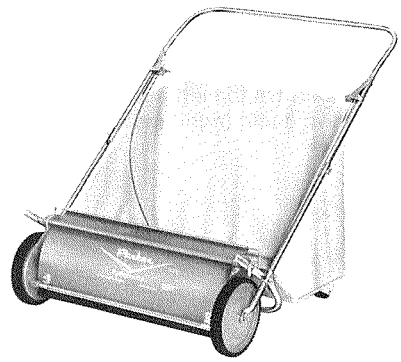


RID YOUR LAWN of weeds with this handy 3-Step weeder: (1) Push the tines into weed's root system; (2) step down on back end of tool to lift out weed; (3) push handle forward to remove the weed from the tines. The 3-Step costs about $22 from Wonder Products Manufacturing Co., Box 186, Arlington, TX 76010.



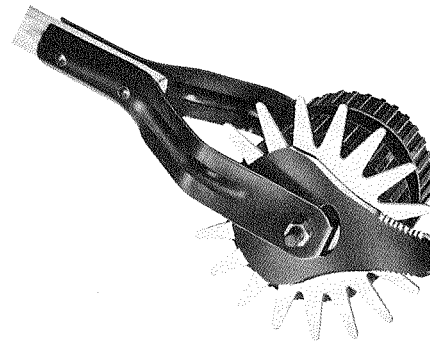


WHEN YOU PUSH down on this seeder in pogo-stick fashion, two planting points enter the ground, opening a hole to your pre-set depth, and a seed is automatically inserted. When you've withdrawn the tool, it reloads itself for the next planting. In most cases the earth falls in over seed to cover it. Golden Harvest seeder (about $27) is from the Lambert Corp., 519 Hunter Ave., Dayton, OH 45404.

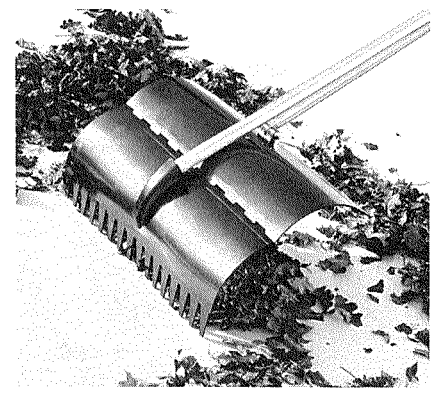


MAINTAIN a well-manicured lawn with minimal fuss by using the Parkerette lawn sweeper. It has a 30-in. sweeper and a basket that holds up to 5 cu. ft. of clippings and debris. The sweeper weighs 42 lbs.; it sweeps with long-lasting polypropylene brushes. The Parkerette Sweeper is priced at about $120. The manufacturer is Parker Sweeper Co., Box 720, Springfield, OH 45501.

AT SELECTED intervals this seeder opens soil, plants and covers a seed, then marks a new row. It comes with six different plates for spacing corn, bean, pea, radish, carrot, beet and 15 other seeds. Precision Garden Seeder (about $45) from EarthWay Products, Box 547, Bristol, IN 46507.



GIVE A CRISP appearance to the border of your lawn with this duckbill edger. Two cross-ribbed tires provide traction to make straight cuts. Star-wheel points pull in ragged growth and hold it for shearing. Cutter is tempered steel. Edger DB 2, (about $18) from True Temper, 1623 Euclid Ave., Cleveland OH 44115.



RAKE LEAVES and debris, then pick them up without stooping by using the Grabber rake (about $20). Lever on handle closes clamshell plate around load. It's especially helpful in cleaning up thorny rose clippings. Made in England, it's available in United States from Encap Products Co., Box 278, Mount Pleasant, IL 60056.

7 ways to get cheap firewood

■ SPRING IS THE BEST time to start replenishing your woodpile. You should find plenty of downed trees and limbs from winter storms. The added benefit of early firewood gathering is the increased drying time between now and next winter.

Begin your hunt for free or almost free firewood by checking out the following possibilities:

1. State and national forests have programs that allow removal of deadwood and, in some cases, the cutting of specified trees. To learn about the opportunities in your state's forests, call the nearest office of the state forestry department. For information about national forests, call the Forest Service, listed under U.S. Government in the white pages of your telephone book. If you live in the West, ask about firewood programs administered by the Bureau of Land Management.

2. Town parks are another source of dead and downed wood. Call your parks and recreation department to find out if it issues permits.

3. Construction sites must often be cleared of trees to make way for excavation. After framing is underway, there will also be lots of scrap (cutoffs) that can be good for kindling. Check your local newspaper for planning commission notices and building permits issued to find out where the clearing and excavating will be done. Contact developers listed for their policy of tree disposal.

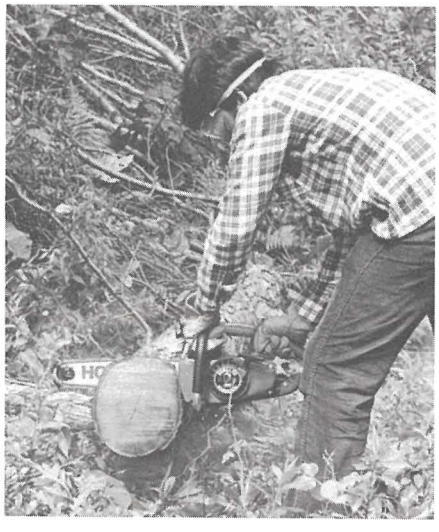
4. Municipal road-widening and sewer projects, as well as routine trimming along roads, produce plenty of potential firewood. Call your local public works department for information.

5. The town dump may or may not pan out. Small-diameter logs are usually grabbed up quickly. If you're enterprising, however, there is frequently plenty of large-diameter stuff to be had—it just needs to be reduced to more practical sizes.

6. Homeowners in wooded areas will often welcome you—and your chainsaw—after a storm has downed trees. Even under normal circumstances, wooded lands often need thinning. For a small fee, the landowner may let you take dead or downed wood.

7. Commercial sources of cheap wood include orchards that require thinning, furniture manufacturers who have leftover scrap and mills that must dispose of slabs (curved, bark-covered sections left after squaring lumber). Commercial logging operations also leave behind treetop branches (slash). Check with the property owner before loading up.

HERE ARE TWO sources of cheap lumber. On the left a chainsaw makes short work of wood cleared from land above an underground pipeline. The town dump (right) may not be picturesque, but can be a good source.



The art of burning wood to get more heat

By JOHN INGERSOLL

Building a warm campfire in a fireplace or stove is a skill that you can learn. Here are some suggested methods for getting the most heat out of a log. Pick the method that suits you .

WENDELL STICKNEY squirmed out of his sleeping bag and tramped over sopping-wet pine needles to the camp's pit fire, banked with wood ashes from the night before. After a rainy night, October mornings in the Maine woods can be bone-chilling.

With a firm length of birch, Stickney cleared away soggy ashes mounded in the pit and uncovered a bed of still-glowing charred wood. He quickly added short lengths of dry, split mountain maple, protected during the night by a tarp. In less than a minute, he had a warming blaze.

What has this got to do with building a fire in a stove, fireplace or furnace? Plenty. The lessons learned over generations of campfire builders apply to blazes by the hearth, as well.

Since its installation Stickney's stove has delivered enough heat to keep his three-bedroom Cape Cod home comfortable with only occasional backup bursts of fossil-fuel energy from a gas furnace.

His secret ingredient that nurtures, controls, saves or extinguishes a Stickney fire is ashes, the fire residue many owners shovel up, sweep out and cart away. "Don't toss them. Use them," Stickney urges.

A bed of ashes 3 to 4 in. deep in a fireplace is Stickney's working supply. In a new or newly cleaned fireplace, 7 to 10 days of wood fires can provide that amount of ashes.

Here's Stickney's step-by-step firebuilding advice:

1. "Take those polished brass andirons or that cast log grate and store them in the attic. A super-hot ember fire will bend, break and corrode metal."

In place of metal, he suggests putting down four firebrick on edge, two to a side. "Where I buy supplies," says Stickney, "I can still get firebrick for 35 cents apiece. Brick will never sag or crack. It does a dandy job." Few people will identify the buried firebrick supporting the logs once the ash bed is deep.

2. Look up the throat of the firebox to see that the flue damper is fully open.

3. Position a large back log so it rests across the brick and against the fireback. "A good example of a back log is a three-way crotch log that's going to be a devil to split. Rather than waste energy challenging it with ax and wedge, make it a back log, as is.

"Let me stop a minute and say a word about the wood I burn," Stickney said to me when I visited him. "The logs are well-seasoned hardwood: hickory, white oak, ash, beech, birch or maple. By seasoned, I mean wood that's been drying under cover out in the open with plenty of ventilation for one year.

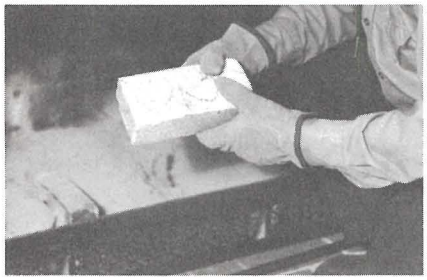
"Pine, fir and spruce make good kindling, but they burn too fast and are too resinous to use for logs.

4. "Pull out one double sheet of newspaper. Holding the outer edges, twist the paper loosely and fold in the ends. You need only one sheet. Lightly press the paper into the ash bed between the bricks, directly in front of the back log.

5. "Over the paper, crosshatch 8 to 10 sticks of dry kindling. Light the paper and stay around. The kindling will flame up and may throw some sparks. Wait through about 10 minutes of burning. Then you're ready for the next step.

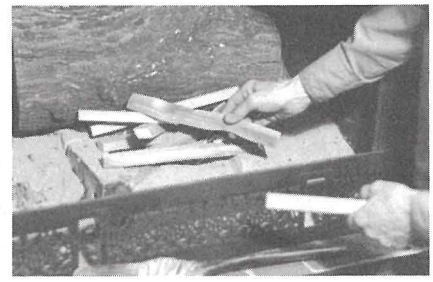
6. "Slip on a pair of heavy work gloves, which ought to be at fireside all the time. Holding it by the ends, place a medium-size split log over the still-burning, very hot kindling. Position it about the space of one finger from the back log. This allows combustion air and gases to rise easily between the logs."

What about a third log forming a triangle over the first two? "I'd do that once in a while if the temperature outside is down to minus 10° F. and the wind is howling. But 98 percent of the time use two logs."



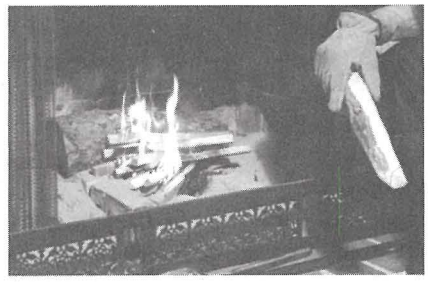
PLACE FIREBRICK on edge to support logs. Andirons are costly and breakable, but brick is cheap and permanent.

HERE'S WHAT the ravages of a hot ember fire can do to cast metal. The middle support is missing, others corroded.

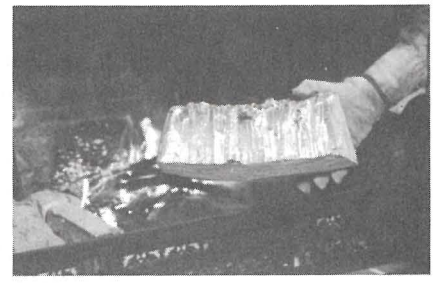


THE LARGE back log is in place, along with a sheet of crumpled newspaper. Now put dry kindling in the firebox.

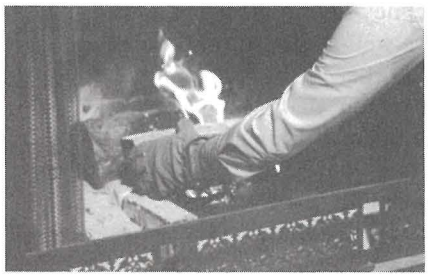
IF THE KINDLING is dry and well seasoned, one match should start a fire which can last for hours of heat.



STAND BY for several minutes while the fire catches. Kindling may throw sparks, or you may need to add wood.

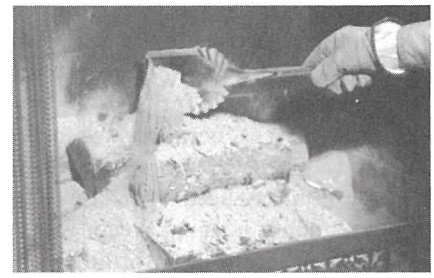


THIS IS the kind of small, split front log that woodsman Stickney recommends placing over burning kindling.

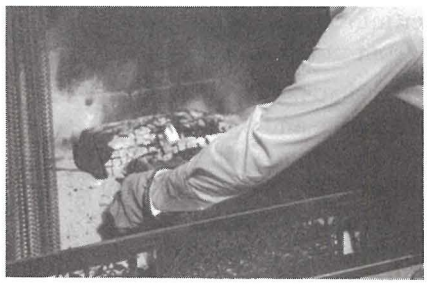


WITH GLOVED HANDS, position front log, taking care to maintain a one-finger space between the two logs.

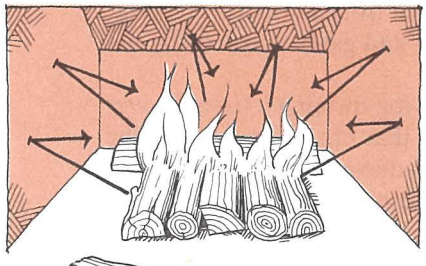
TO GET a slow burn from the fire, mound ashes under logs. This reduces, but doesn't eliminate, circulation.



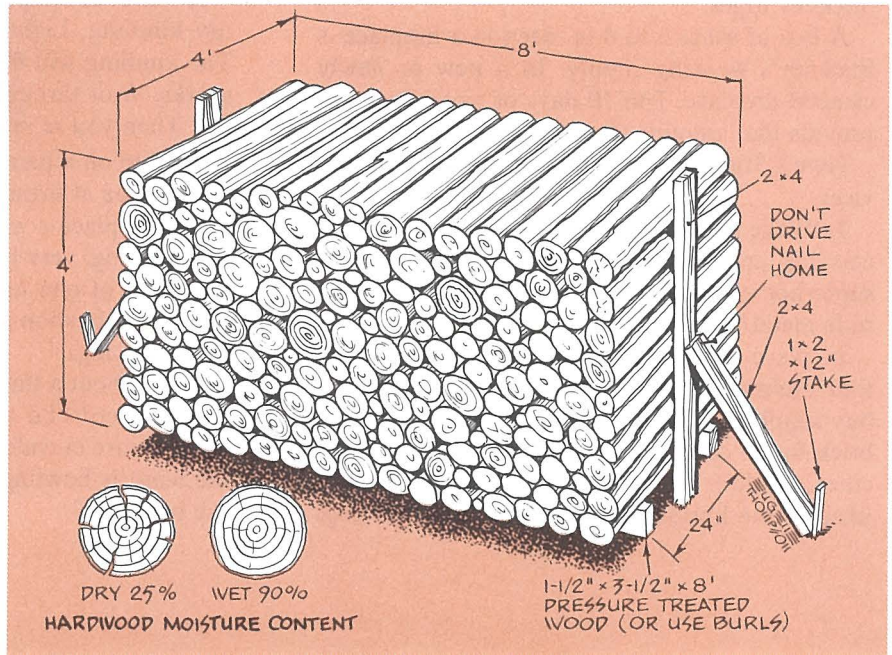
TO SAVE fire until following morning, push both logs together and cover everything with the available ashes.

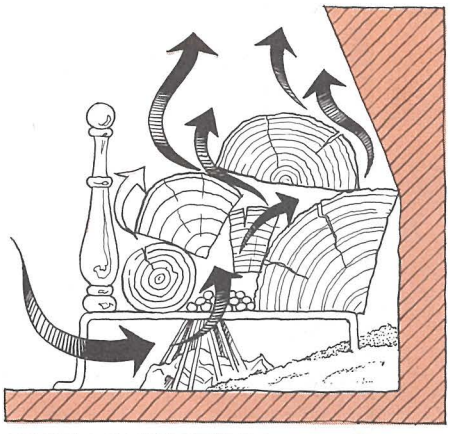


TO SAVE WOOD for another burn, roll front log forward; rotate back log to expose its embers; cover with ashes.

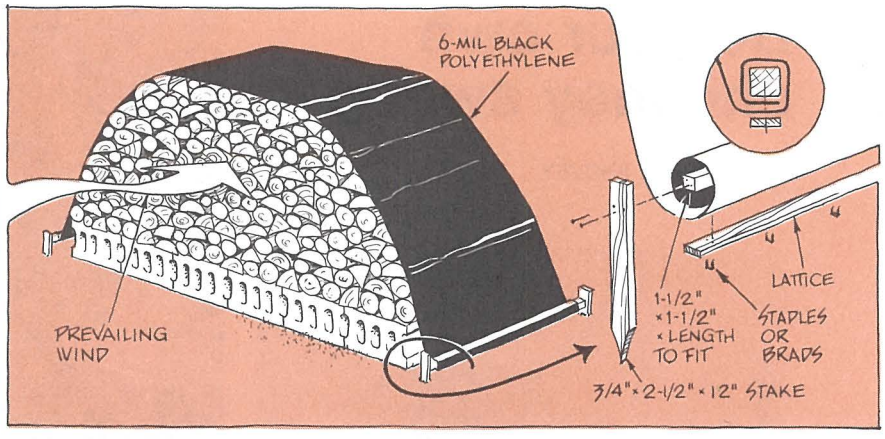


BENNETT-IRELAND'S ADVICE for starting a fire (below, left) calls for eliminating all supports and building the fire directly on the firebox floor. A cord of wood (below) measures 4 x 4 x 8 ft. Notice that logs are not yet split. Log end views tell you whether wood is dry or still green.





FIREPLACE INSTITUTE favors a fire with three to five logs, traditional andirons or grates and a 1 to 2 in. ash bed.



A BLACK POLYURETHANE cover not only protects the woodpile from weather, but absorbs the sun's heat to produce a kind of natural kiln that dries the wood faster. An arrangement of stakes and lattice straps will keep the polyurethane in place.

When the ember fire burns low, Stickney packs on a dry split log, again with a one-finger space between logs. "A big back log lasts two to three days."

Ashes can control the fire in four ways, according to Stickney.

"To make logs burn faster, dig out some of the ashes from beneath the logs. This increases the volume of air beneath the fire for combustion.

"If you want a slow burn, a tiny glow to last all evening, mound up ashes beneath the logs. That cuts down, but doesn't cut off, air for combustion.

"To save the fire, push the logs together and cover the logs and embers with ashes. Next morning, scrape away the ashes and you'll find the remains of your logs still red. Just put on fresh logs.

"To save the logs until morning, roll the front log toward you until the portion burning is exposed. Rotate the back log away from you until its burning surface is exposed. Cover embers between with ashes and, if you like, scatter a few ashes over the logs. When you wake, the fire will be cold and the logs reusable."

Stickney applies Steps 2 through 6 to operate his stove, but he uses less material, since the firebox is smaller.

His goal is the same. He wants glowing live coals resting snugly in a bed of ashes.

Stoves delivering primary combustion air through a grate beneath the wood can't operate with a thick bed of ashes, since the ashes drastically cut airflow.

Nor could this system work in wood furnaces that draw combustion air from beneath the fire. Moreover, air vents on new furnaces are usually tied to a thermostat. So the Stickney method for starting a fire (minus the ashes) is fine. But once started, the fire is controlled by signals from the thermostat to the air vent. Your job: feed the fire; dump the ashes.

Not everyone agrees with the Stickney system for a fireplace fire. Here are two more methods:

First, Bennett-Ireland Inc., Norwich, NY, sides with Stickney on removing andirons and log grates. Their advice: Build your fire over the firebox floor.

Place a large back log on the brick chamber floor so it rests against the fireback. Next, crumple newspaper and add some kindling if you like, though B-I says kindling isn't needed if you use well-seasoned logs.

Now rest the ends of four or five small, split logs over the back log, lean-to fashion. Choose splits no more than 16 in. long or 4 in. in diameter. Light paper.

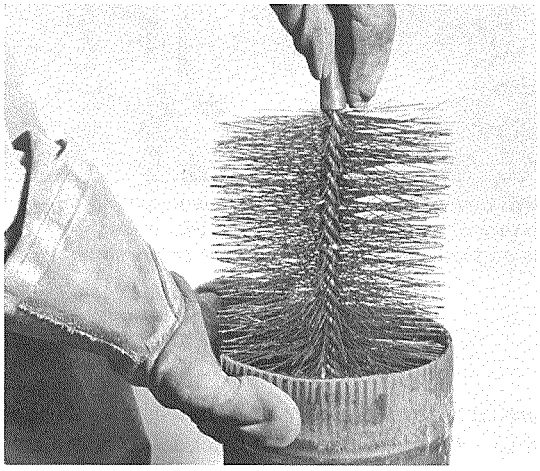
What about the ashes? Bill Sheehan of B-I says, "It's a good idea to leave a layer of ash over the firebox floor."

On the other hand, The Fireplace Institute, an association of fireplace appliance and accessory manufacturers, distributors and dealers, hews to the traditional. It favors andirons or a metal grate.

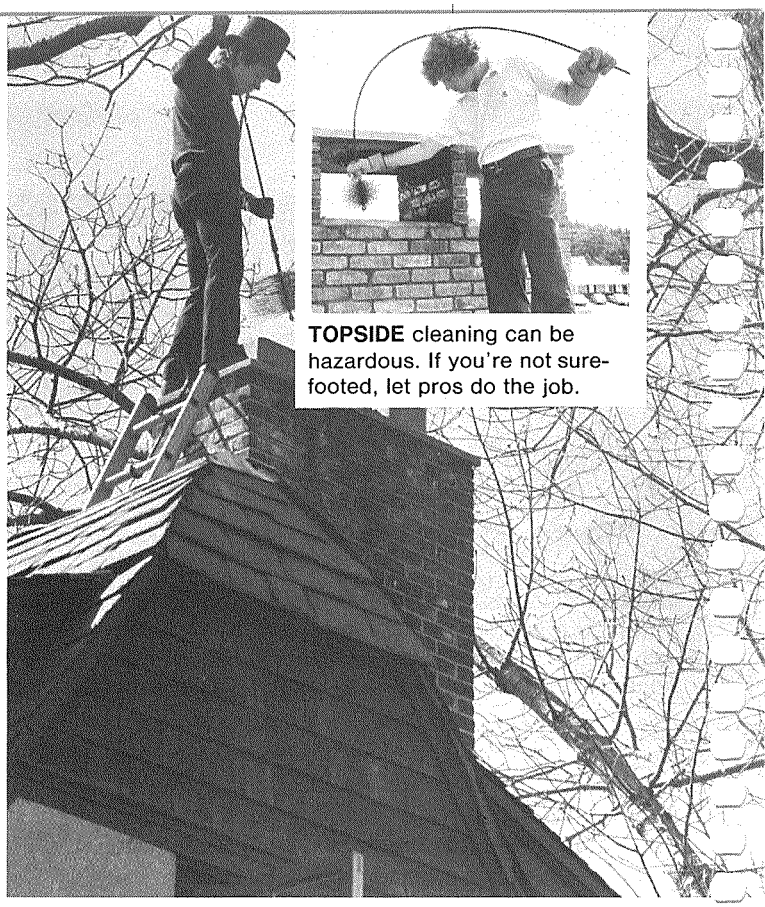
The institute also recommends picking a large back log, then a smaller front log spaced about 6 in. from the back log. Between the two, build a teepee of kindling over crumpled newspaper. Fill the middle space with two or three logs, allowing small spaces between all. Light the paper.

Be your own chimney sweep

By JOSEPH R. PROVEY



BRUSH OF PROPER size and shape is prerequisite: Too small a brush won't clean; too large might jam.



TOPSIDE cleaning can be hazardous. If you're not sure-footed, let pros do the job.

■ WOOD-BURNING fireplaces and stoves are sweeping the country. But who sweeps the chimneys and stovepipes which carry smoke and gases out of the house? In at least 40,000 cases, the answer is, "Apparently, no one." This is how many chimney fires occurred in a recent year.

Chimney fires result from creosote buildup. According to August West Systems Inc., a chimney-sweep company in Westport, CT, the accumulations can be ignited if you burn a slightly larger or hotter fire than usual.

Unfortunately, creosote buildup occurs more quickly in well-constructed and properly installed systems. "If your system is very energy-efficient in heat transfer—that is, it recovers most of the heat of combustion—you can count on fast rates of (creosote) buildup," states Black Magic Chimney Sweep Inc., of Stowe, VT.

To reduce creosote buildup, while keeping the system as efficient as possible, burn dry hardwood and add fuel in small amounts, rather than large loads. The most positive safeguard against a chimney fire, however, is frequent inspection for creosote buildup and sweeping of the chimney or stovepipe *before* buildup.

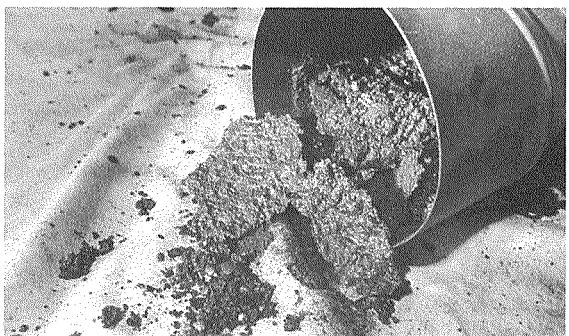
The National Fire Protection Assn. recommends that you inspect and clean a chimney annually. Use a powerful light and mirror to look up the flue. If bricks appear black or furry, sweeping is needed.

Black Magic Chimney Sweep Inc. is more specific: "Fireplaces, generally, don't need cleaning every year unless they get heavy use—four or five times a week. If the buildup is ¼ inch or more, clean the fireplace or chimney."

As for woodburning stoves, they should be cleaned at least once a year—more frequently if the stove is the primary source of heat.

PROFESSIONAL SWEEP should be well equipped, guarantee clean-up and carry insurance. Average fee is about $40.

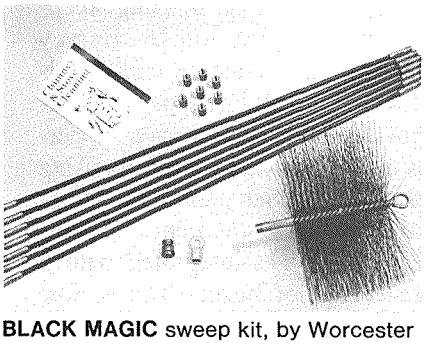
CREOSOTE occurs in several forms, from syrupy liquid that dries to tough glaze, to powdery crusts shown below.



There are several approaches to cleaning a chimney, but the two basic rules are: Use the proper tools and make every effort to contain the mess. The right tool for flue cleaning is a wire brush sized for your flue—not a bunch of tire chains or an evergreen tree.

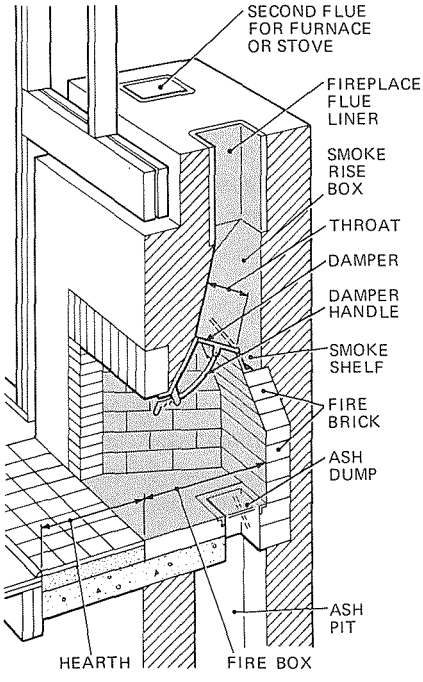
Containing the mess starts with being overcautious. I use about two Sunday newspapers' worth of paper. Tape the sheets together to cover the hearth and toss the whole pile when your finished. Sweeping chimneys when the outside temperature is below 40° F. makes for the best draft, minimizing the chance of soot entering the room.

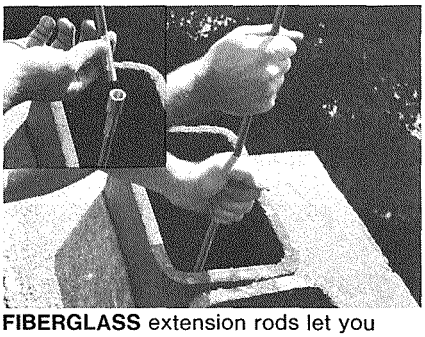
Using extension rods on your brush, you can sweep from the inside or from the roof. From the inside, first remove the damper (if it's removable) and insert the flue brush with a couple of rods attached into the flue. From the roof, leave the damper closed and cover the fireplace opening as an extra precaution. Either way you have to reach through the fireplace throat to shovel ashes from the shelf.



BLACK MAGIC sweep kit, by Worcester Brush Co., Worcester, MA, is about $45 to $76, depending on brush size.

AS PRECAUTION against airborne soot, tape old sheet or newspapers to fireplace opening before scrubbing from roof.





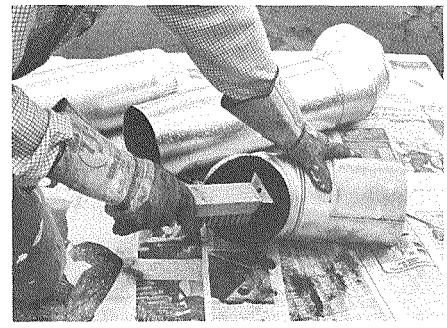
FIBERGLASS extension rods let you scrub entire flue. Clean one section at a time, adding rods as you descend.

FLUE CAN also be scrubbed by tying rope to both ends of brush, stationing helper below and alternating pulls on ropes.

CLEAN CREOSOTE accumulations from firebox walls with a hand wire brush. Trouble light lets you spot buildup.

AFTER REMOVING damper, scrub with wire brush. Then clean smoke-rise box, using flue brush with one or two rods.

CAREFULLY SCOOP creosote from smoke shelf into trash bag. If you don't own ash shovel, use child's sand shovel.



DON'T NEGLECT dirty stove pipes either; ¼-in.-thick encrustations should be scrubbed before cleaning stove.

5 ways to get more heat from a furnace

■ DEPENDING ON THE TYPE, vintage, location and fuel used by your furnace or boiler, considerable savings can be made by taking one of several courses. Note, however, that the course you choose *must* be tailored to your system—and that some devices will negate the effectiveness of others.

1. Replace an old, inefficient burner

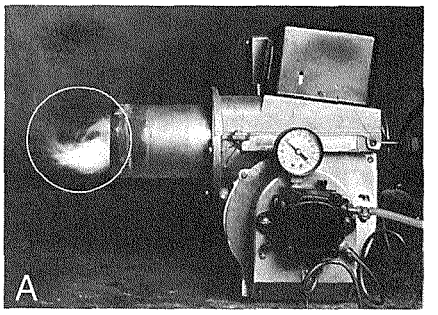
If you burn oil, you expect at least six more years of service from your boiler or furnace, and you have not replaced your old burner with a flame-retention-head burner, do so as soon as possible. They have been around for about 10 years and their higher efficiencies are well proven. According to field tests by Brookhaven National Lab (BNL), you will achieve fuel savings between 5 and 22 percent. Note that the higher operating temperatures of these burners may require the addition of a refractory liner to existing stainless-steel chambers.

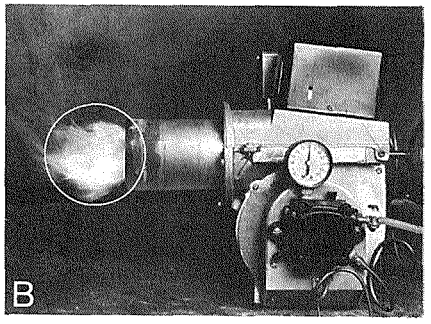
The latest in retention-head burners are high-static-combustion-pressure units. They achieve extremely high burner efficiencies by stabilizing the combustion airflow and optimizing the fuel/air mix. Hotter flames are achieved with less oil.

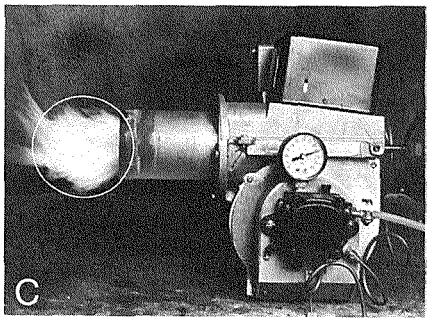
A U.S. manufacturer, Sloan Valve Co., is now producing a high-static burner known as the Interburner. It was developed by Saab-Scania and can achieve a steady-state combustion efficiency of 87 percent. Steady-state efficiency is measured while the burner is operating and represents the peak efficiency of a system.

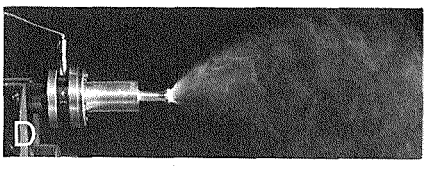
The most exciting advance in burner technology comes from Sono-Tek Corp. in Poughkeepsie, NY. Carl Levine, president, and Dr. Harvey Berger, vice president, have come up with an ultrasonic nozzle that will, in all likelihood, revolutionize the oil-burner industry and save 35 percent in fuel costs for homeowners currently using an average-efficiency unit. (See photos.) In cooperation with Wayne Home Equipment and Sunstrand Corp., the nozzle was integrated with a high-static-pressure type of burner and it now can produce steady-state efficiencies of 88 to 89 percent.

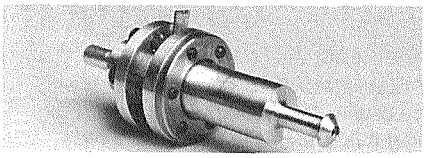
More important, low firing rates and a modulating capability make possible overall efficiencies *significantly greater* than the previous 76 percent high for oil-fired units (as pegged by BNL). Overall efficiency is the heat which enters your distribution system divided by the total amount of heat available in a given fuel.



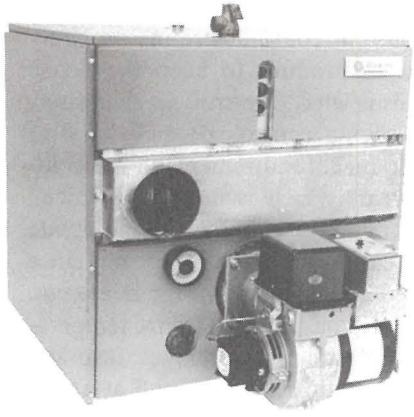


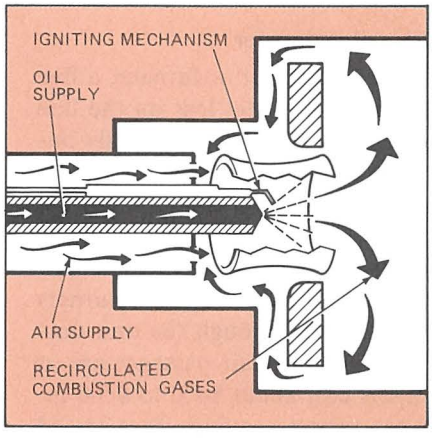






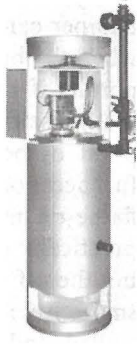
A REVOLUTIONARY ultrasonic nozzle enables this burner to modulate its firing rate over a range of 0.2 (A) to 1.0 (C) or more gallons of fuel oil per hour. Low firing rates reduce the frequency of heat-wasting furnace start-up and cool-down phases. Modulating capability allows the burner to be fine-tuned to react to changes in the outside temperature. A new nozzle (E) can convert a few watts of electrical power into intense, high-frequency vibrations at the cone-shaped tip of the nozzle. The oil is atomized (D).



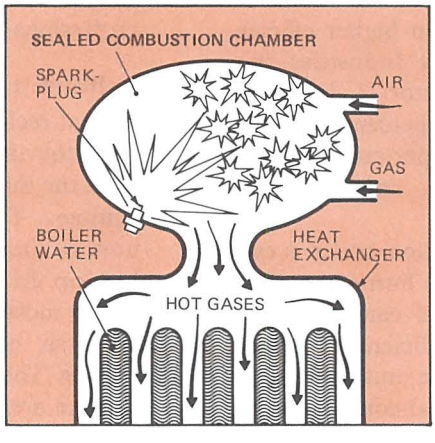


BURNER and combustion-chamber design of Blueray boiler (top) makes incompletely burned gases recirculate to point of combustion. Operation is nearly soot-free.

FLUE DAMPERS, like this one from General Machine Corp., have a metal disc that pivots to stop the draft when the burner is off.



IN Hydro-Pulse heating unit (above and left), air and gas are mixed in a sealed chamber and ignited. Hot gases are forced through a heat exchanger surrounded by boiler water (below).



ENERTROL unit uses its indoor and outdoor sensors to determine the precise amount of heat that must be produced.

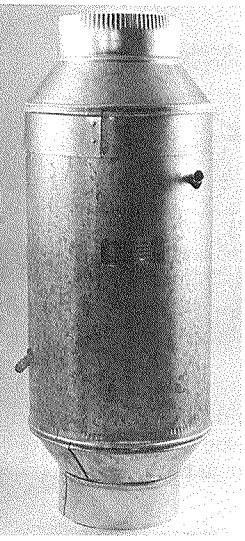
ENERTROL model, suitable for boilers with tankless coils, allows you to program for periods of high use.

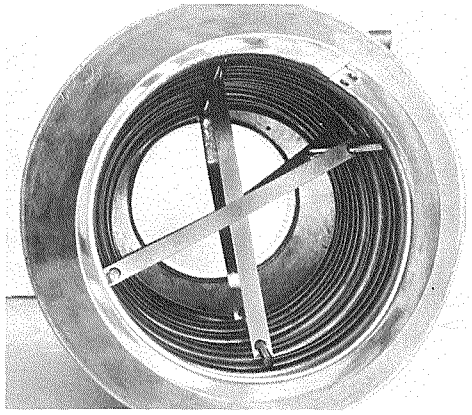
Low firing rates and flame modulation allow a more continuous flame to be used—instead of short, high-flow-rate blasts of flame. A modulating flame, tuned to changes in outdoor temperature, allows the boiler water or air in a hot air system to be heated to precisely the degree needed by the house, eliminating overshoot problems of conventional systems. The results are: less heat lost up the flue when the burner is operating; reduced off-cycle time, during which sizeable heat losses occur; and, ultimately, less oil burned.

2. Install a new heating unit

A new, high-efficiency boiler or furnace represents an investment that can range from $1200 to $3000, significantly higher than that needed to retrofit a new burner. The payback is consequently longer, in spite of the fact that greater savings can be realized—23 percent or more in many cases.

Overall efficiencies (the ratio of heat reaching your distribution system compared to the total amount possible from the fuel) for best oil-fired furnaces and boilers will exceed 72 percent.





A HEAT RECLAIMER, from Precision Systems (left), transfers heat from exhaust gases in the flue to the hot-water heater by way of this copper-coil heat exchanger (above).

Overall efficiencies for gas-fired furnaces and boilers can range even higher.

One manufacturer, Blueray Systems Inc., has developed an oil-fired boiler (see photo) and furnace capable of recirculating unburned gases for more complete combustion. Tests at BNL have shown that an overall efficiency of nearly 76 percent—23 points higher than the average oil-fired unit in many of today's homes—can be achieved. The installed price of the furnace is about $1600; of the boiler, $1800 to $2000.

Among the gas burners, even higher efficiencies can be achieved. Lennox Industries Inc., manufacturer of the Conservator II, boasts an overall efficiency of up to 82 percent. The unit comes with a built-in flue damper and electronic spark ignition, instead of an energy-wasting, standing pilot light.

Hydrotherm's pulse combustion boiler is even more impressive. It requires no burners, no pilot light, no flues or chimney and can reduce gas consumption by 30 percent. Efficiencies of up to 90 percent can be reached. The unit operates on the same principle as an internal-combustion engine. Outside air is used for combustion and low-temperature exhaust is eliminated through the house wall in a plastic pipe. Sound problems, previously associated with this technology, have been reduced to the level of a household refrigerator with the compressor on.

The price of the boiler is about twice as much as a conventional boiler, but the payback, estimated by the manufacturer, averages only about 3½ years. Hydropulse units can also be adapted to hot-air distribution systems.

3. Give your boiler a brain

If your gas or oil boiler "knew" the temperature outside and the amount of heat being produced in the house, it could determine precisely how much heat to produce to keep the house comfortable. This is what Enertrol, an electronic, solid-state, fuel-saving control, does. Instead of setting a boiler to meet requirements of the coldest day of the year (which is normal practice), boiler water temperature is allowed to fluctuate with need. This can save 15 to 25 percent, since less fuel is burned and heat loss up the flue is cut.

The unit also lets you program house temperature setbacks, domestic water temperature setbacks and an automatic system shutoff at a predetermined temperature.

4. Save fuel with a flue damper

If you own a gas-fired boiler or furnace, a flue damper can help minimize heat loss up the flue when the burner is not on. This is especially important if your unit is located in a heated area of the house. Flue dampers are less effective, to the point of being a poor investment, on oil-fired furnaces or boilers already equipped with a flame-retention-head burner. These burners practically eliminate draft through the unit during the off cycles, since their air passages are so small. Flue dampers cost about $400 to $500 installed, and you can expect a savings from 2 to 14 percent. Installation should be by a qualified professional.

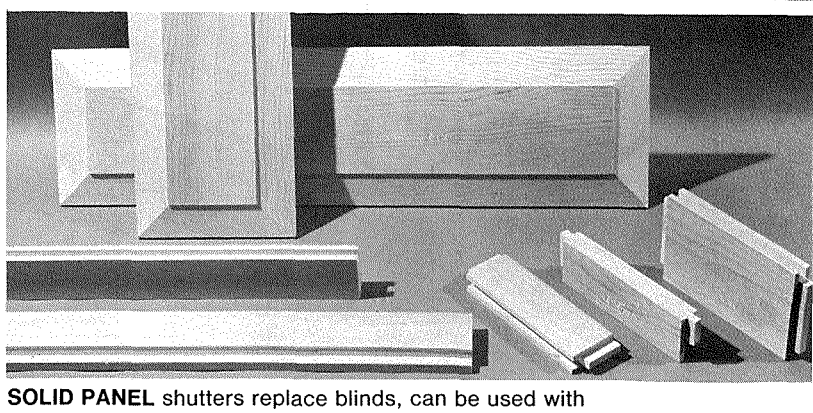
5. Install a flue heat reclaimer

Heat reclaimers come in many types. The one thing they have in common is that they take heat from the flue that would otherwise be lost up the chimney. They don't make much sense if your unit is already efficient and doesn't lose much heat up the flue.

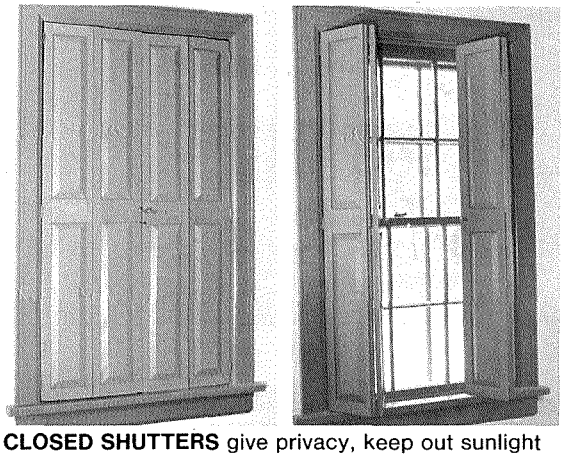
The most common type of heat reclaimer is an air-to-air heat exchanger powered by a small blower. The heat can be used in the immediate furnace area or be ducted to a nearby room.

MANUFACTURERS LIST

American Stabilis Inc., Industrial Park, Lewiston, ME 04240; electronic fuel-saving control
Blueray Systems Inc., 22 Berger St., Schuylkill Haven, PA 17972; blue-flame furnaces and boilers
General Machines Corp., Fourth and Furnace Sts., Emmaus, PA 18049; furnaces, boilers, flue dampers, heat reclaimers
Hydrotherm Inc., Rockland Ave., Northvale, NJ 07647; pulse combustion heating unit
Lennox Industries Inc., Box 400450, Dallas, TX 75240; high-efficiency gas furnaces
Precision Systems Inc., Cane Mountain Resort, Snow Camp, NC 27349; flue heat reclaimers
Sloan Valve Co., 10500 Seymour Ave., Franklin Park, IL 60131; high-static burner
Wayne Home Equipment, 801 Glasgow Ave., Fort Wayne, IN 46803; high-static and ultrasonic oil burners



SOLID PANEL shutters replace blinds, can be used with or without drapes. Make them from panels, rails, stiles.



CLOSED SHUTTERS give privacy, keep out sunlight and add old-world charm. Partly opened shutters direct sunlight and its warmth while allowing an outdoor view.

Old-time shutters look great— and save heat

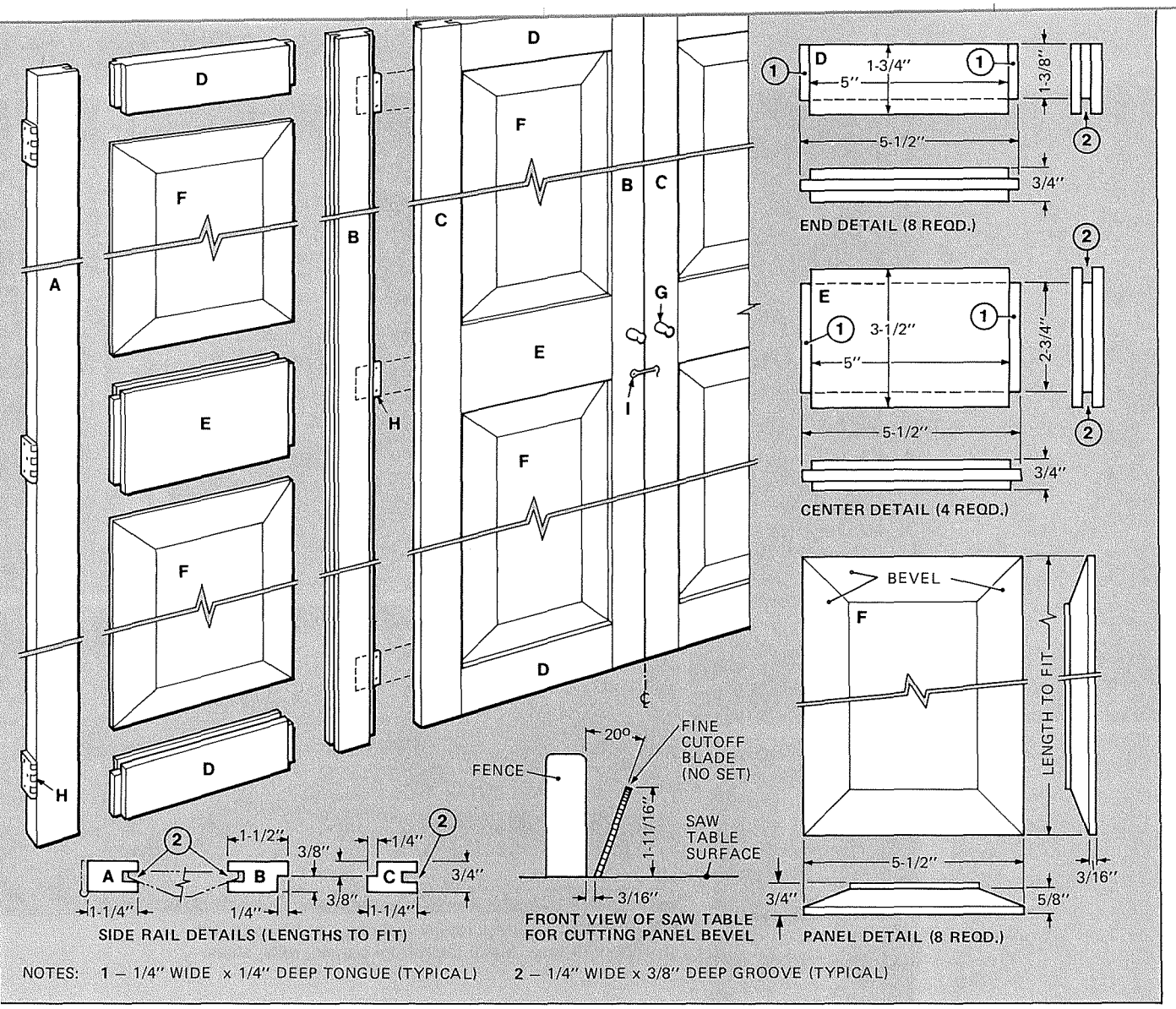
By ROY R. COTTRILL

Your shop-built shutters will blend with most surroundings, as they can be either painted or stained. During the day, open them to the view; at night, close them to the chill

YOUR WORKSHOP efforts making these solid-panel shutters will be repaid in several ways. Besides being decorative, the shutters, when closed, will stabilize airconditioning costs in summer and heating expense in winter. Closed, the shutters give you total privacy. They open partially or fully for varying degrees of visibility and light. Our colonial ancestors used similar shutters to keep out wild animals and hostile Indians.

Use almost any available kiln-dried wood to make the shutters—those shown are made of clear pine. All framing and raised panels (F) are made of ¾-in. stock. The estimated cost per window can be as low as $7 to $10. We installed shutters on 12 windows at a cost of slightly more than $100.

Plans shown are for a standard 30-in.-wide window. Panel heights can be varied to fit the particular window opening.



The secret of easy-operating shutters is to build them with exact 90° corners and straight, parallel sides. (*Editor's note:* Do take time to select only warp-free lumber to build shutters; warping will ruin your work.)

Cut panels from 1 x 6 stock to proper length (see materials list, page 87). Set the saw blade to make a beveled face 1⅜-in. wide around the entire panel, and the fence to leave an outside edge 3/16-in. thick (see drawing above). To be safe, make a test bevel on a scrap of wood first.

Bevel the ends (across the end grain) first; then the sides. A jig of scrap-wood blocks (see first photo on this page), is helpful. You can bevel along the panel length without the blocks, but hold the work firmly and use a slow feed. Keep the panel firmly against both fence and saw table. Finally, use a fence or miter gauge to square off the shoulders on the work face.

cutting the frame

Cut stiles A, B and C to length. Rabbet one edge of stiles B and C ¼-in. wide x ⅜-in. deep. Rabbets of the center stiles overlap to insure your privacy when the shutters are closed.

Stiles A are hinged to the window frame and are not rabbeted. Order of stiles across one window is: A, B, C, B, C, B, C and A (one set).

When you cut a rabbet with an adjustable (wobble-type) dado blade, the actual line of cut can't be measured from blade to fence. To get a cut precisely as you want it, adjust the blade for cutting width, set elevation using a ruler, and run a scrap of wood through the blade. Check the cut with a ruler and mark the line of cut on the blade insert with a pencil.

Stile A is grooved ⅜-in. deep with a ¼-in. setting on the dado blade. You can also groove it with about three adjacent passes using a rip blade.

Next, cut the top and bottom rails D and center rails E. Groove rails on the inner edge to fit panel F; groove center rails E on both top and bottom edges. Apply steady downward pressure

at front and rear to cut the pieces.

Cut a ¼ x ¼-in. tongue on each side of rails D and E to mate them with the stile grooves. A block setup like that used to bevel the panels will help.

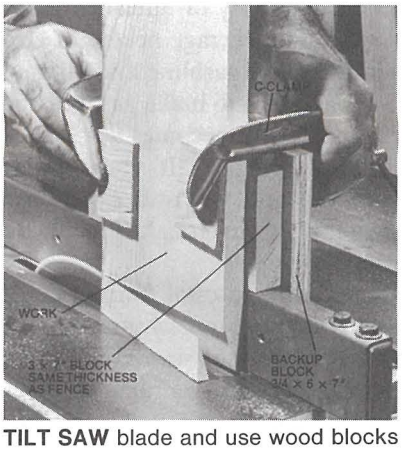
assembling the shutters

Test-fit all pieces dry. Then sand before final assembly. Tongue-and-groove construction gives panels F room to expand or contract with temperature and humidity changes. The raised panels aren't glued; they "float" in the grooves.

Before adding shutter hardware, set the four sections in the window opening and adjust spacing to allow for the hinges and the rabbet overlaps. Plane the edges if you think it's necessary.

Sand, dust and wipe with a tack cloth between each of these finishing steps.

Apply pigmented shellac such as Bin or Enamellac to seal the wood, then two coats of a satin-finish enamel paint. Or you might seal the shutters and apply a stain finish followed by varnish.



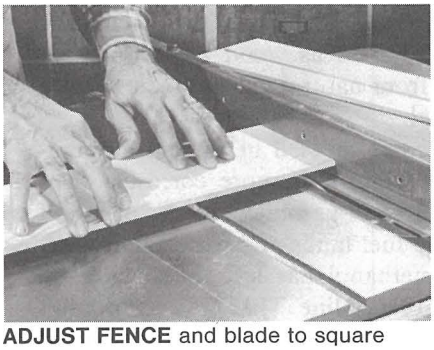
TILT SAW blade and use wood blocks to cut bevels on the ends of panels (F).

YOU CAN cut side bevels without blocks. Stand behind fence for control.

MATERIALS LIST—SHUTTERS
(for 1 set, 4 sections)

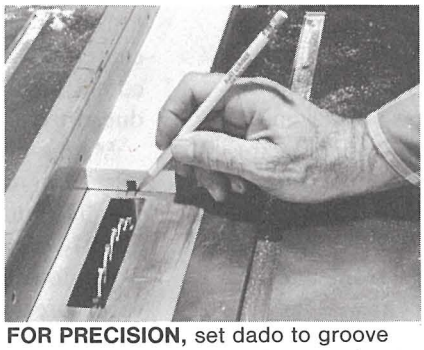
Key	Pcs.	Size and description (use)
A	2	¾ × 1 3/16" × to fit (side stile)
B	3	¾ × 1⅜" × to fit (center stile)
C	3	¾ × 1 3/16" × to fit (center stile)
D	8	¾ × 1¾ × 5½" (top, bottom rail)
E	4	¾ × 3½ × 5½" (center rail)
F	8	¾ × 5½" to fit (panel)
G	2	shaped or purchased (pulls)
H	12	1½ × 1¼" butt hinges, brass finish
I	1	shutter hook and catch

Misc.: carpenter's glue; pigmented shellac such as Bin or Enamelac; satin-finish enamel paint; sandpaper.



ADJUST FENCE and blade to square off panel shoulders. Make test cuts on scrap.

WHEN GROOVING short pieces (D,E), apply pressure at the front and the back . . .

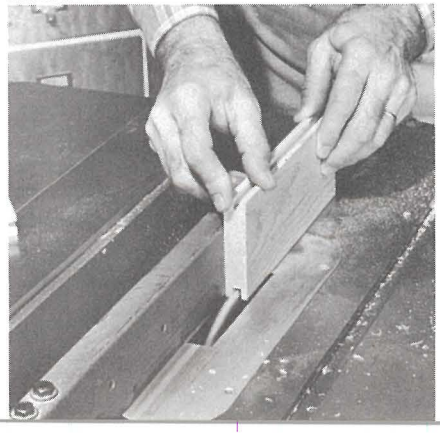


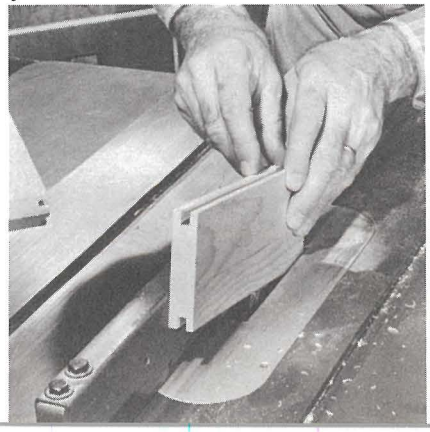
FOR PRECISION, set dado to groove width, test on scrap, mark cut on inset.

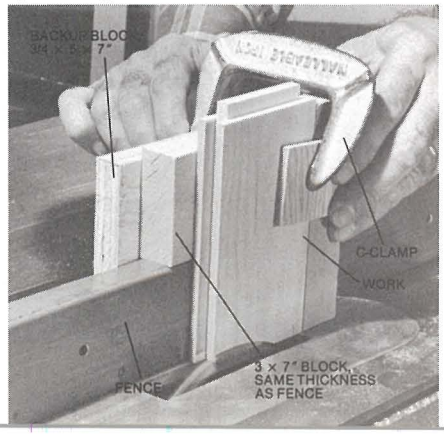
IF YOU DON'T, the groove won't be uniform. You may damage the work or your hand.

WHEN GROOVING rabbeted stiles (B,C), have push stick ready for use.

USE TWO BLOCKS as aids in cutting tongues in D and E. Rear block stops splintering.







After 47,000 miles on gasohol—a clean engine

By MORT SCHULTZ

■ CONFUSED by all the contradictory statements about the gasoline and ethanol mixture called gasohol? I was, too. So, I decided to find out for myself what, exactly, this fuel does to your engine.

I visited Buzz Marcus Toyota Co. in Glenside, Pa., because, up to now, probably no other outfit has operated cars more miles on gasohol than Marcus.

We disassembled an engine that had been driven since new on nothing but gasohol. In fact, it was operated most of these miles, not on the conventional mixture of 90 percent gasoline and 10 percent ethanol, but on an 80- to 20-percent blend.

The carburetor was like new. There was no dirt and no varnish, and metal and nonmetal parts showed no signs of corrosion. This is particularly interesting since the General Motors Research Laboratory in Warren, Mich., found that when testing gasohol in an engine on a laboratory test bench, some fuel system materials, notably elastomers, deteriorate more with gasohol than with gasoline.

When we pulled the head, there was no evidence of sludge or carbon buildup, although there was a thin layer of soot in the combustion chambers. The valves were clean.

Cylinder walls were shiny and so was the exhaust header. The only carbon present was on the tops of pistons. The amount was insignificant, and no more than would be present in an engine run 47,000 miles on gasoline and maintained properly.

I also removed the sparkplugs from another engine that had been running on gasohol for 15,000 miles. They were clean and showed practically no wear. The plugs on the 47,000-mile engine were changed every 15,000 miles; so when I saw them they had only a couple thousand miles on them.

As far as I could see, gasohol is probably better for your engine than straight gasoline. Nevertheless, you may run into some problems when you make the switch. We'll discuss them later. First the good news.

higher octane

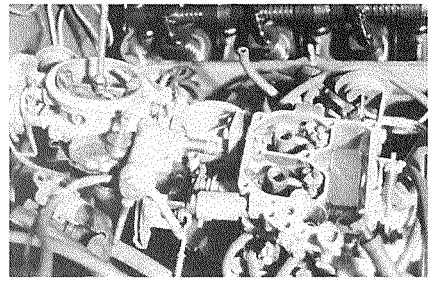
The average octane quality of unleaded gasoline these days is 87. The average octane of ethanol is 98. When unleaded gasoline and ethanol are mixed at the 9-to-1 ratio to make gasohol, the average octane of the blend becomes 90. This is sufficient to eliminate pinging. If your engine timing is set correctly and you still experience some pinging, switching from straight gasoline to gasohol will probably cure it.

When you do switch to gasohol from gasoline you don't have to modify or adjust your engine at all. I've run my Pontiac V8 for several thousand miles on a 9-to-1 gasohol with no modifications.

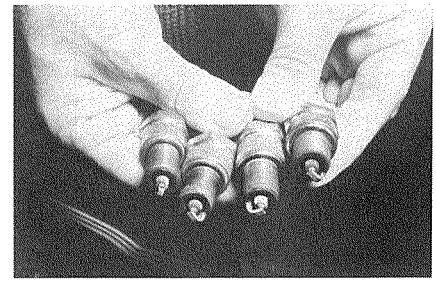
Ethanol is an excellent motor fuel and very compatible with gasoline. It is made by fermenting and distilling crops such as corn, wheat, alfalfa and sugar cane. It differs from methanol, commonly referred to as wood alcohol, which comes mainly from natural gas and can be produced from coal.

Methanol *cannot* be used in present automobiles. For one thing, it is more corrosive than gasoline and ethanol-gasoline blends, and will quickly damage fuel tanks and carburetor parts. For another, methanol has less than twice the vapor pressure of gasoline. That means it doesn't vaporize very well and tends to remain a liquid in engines. In testing methanol and methanol

THE CARBURETOR fuel bowl has no sludge visible after a total of 47,000 miles on gasohol.



CHANGED every 15,000 miles on gasohol, the sparkplugs shown here are free of carbon deposits.



blends in engines, GM found that it created starting problems, poor warm-up performance, stalling and lack of acceleration. Such is not the case with ethanol. There are, however, other problems worth mentioning.

The water content in alcohol, for one, can give trouble, but I haven't experienced any. The alcohol in gasohol is 192 proof. Pure alcohol (no water) is 200 proof. Alcohol of 192 proof is 96 percent alcohol and four percent water, which isn't enough to cause a major problem.

However, some people are experiencing plugged fuel filters. The reason is that alcohol in gasohol may separate in cold weather and cause water to accumulate in the fuel tank. If a large quantity of water is pumped through the fuel line, the filter will clog. The alcohol in gasohol tends to act as a solvent. If there is dirt in the fuel tank or fuel line, alcohol may loosen particles and carry them through the fuel line to the fuel filter.

If you use gasohol and your engine becomes hard to start or begins stalling, the first thing to check is the filter.

Joseph Colucci, manager of the Fuels and Lubricants Dept. at GM Research Laboratories, cautions that you may experience other driving problems with gasohol, especially in models which do not have a closed-loop (feedback) fuel system. Some 1979 and many 1980 models possess this electronically controlled system.

"The oxygen in the fuel (ethanol is a partially oxidized hydrocarbon) causes vehicles to operate three percent leaner with gasohol than with gasoline," Colucci advises. "This leaner operation can increase problems such as surge, hesitation and stalls."

The ideal (stoichiometric) air/fuel ratio of gasoline is 14.5 to 1. That is, 14.5 parts of air for one part of gasoline. The ideal ratio for gasohol is 13.9 to 1. Therefore, when gasohol is run through your carb, which was designed for gasoline, the mixture will automatically be leaner than ideal for gasohol.

Another potential problem you may encounter is an increase in vapor pressure that occurs when running on gasohol. Generally, gasoline has a vapor pressure of 10 pounds per square inch (p.s.i.). The addition of ethanol raises the pressure to about 10.7 p.s.i.

This increased vapor pressure can cause vapor lock in hot weather. A vapor lock condition occurs when fuel boils in the fuel pump or fuel line. The resulting vapor blocks the flow of fuel to the carburetor, causing the engine to shut down until things cool off.

As a precaution, if you are going to operate a car on gasohol in hot weather, carry a Thermos of cold water. Cold water poured on a fuel pump and fuel line will relieve the vapor lock.

mileage increase is small

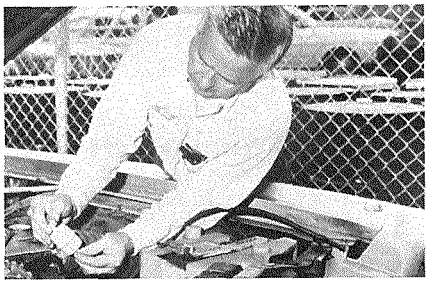
As for the question of fuel economy with gasohol, if there is an increase, my experience has been that it's too insignificant to notice. However, Marcus Toyota claims that its gasohol-driven Toyotas get a 3.5-percent increase in fuel economy compared to a similar car using gasoline.

Furthermore, Illinois Bell Telephone conducted a six-month experiment, running 15 vehicles on gasohol and 15 comparable vehicles on gasoline. A company representative told me they showed an increase in mileage of 4.3 percent for the gasohol-fed cars.

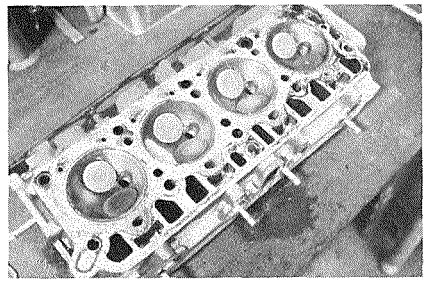
Conversely, the Solar Electric Research Institute (SERI) says, "Most tests indicate that cars achieve more miles per B.T.U. with alcohol. However, since alcohol contains fewer B.T.U.s of energy per gallon than gasoline (110,000 for gasohol; 114,000 for gasoline), the mileage performance of gasohol does not differ significantly from that of gasoline, especially in new cars."

Let me leave you with a word of caution: If you own a new car and get your hands on some 192+ proof alcohol, don't exceed the 9-to-1 gasoline-to-alcohol ratio. New car warranties cover vehicles that use gasohol containing only up to 10 percent ethanol.

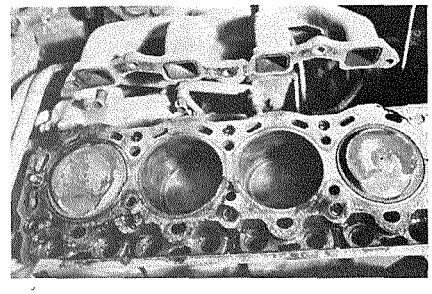
GASOHOL will dislodge dirt and rust from the fuel tank. The fuel filter should be checked often to prevent stalling.



THE VALVES are clean and show little wear. The black deposit on the combustion chamber is merely soot.



THE ONLY carbon buildup occurred on the piston crown. It was less than that found in engines run on straight gas

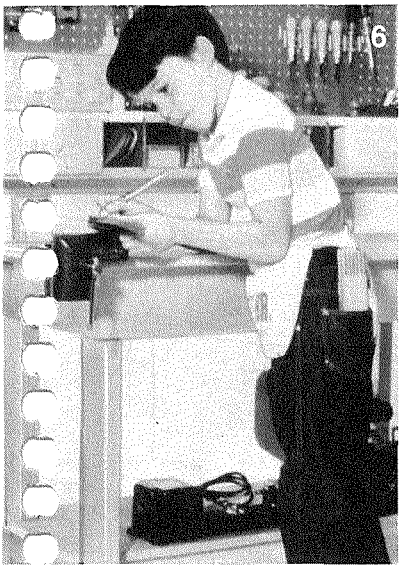


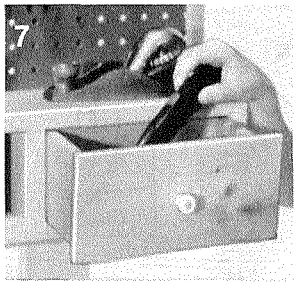
A bench for a craftsman (and one for a junior craftsman, too)

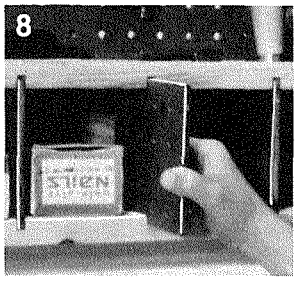
■ MOST CRAFTSMEN will agree that a solid workbench is the heart of any workshop. You use a bench for planning a project and laying it out, for cutting, sanding and assembly and, with care, for some finishing operations. Presented here are two benches that include the necessities: roomy tops, storage, strength, and vises for good holding capabilities.

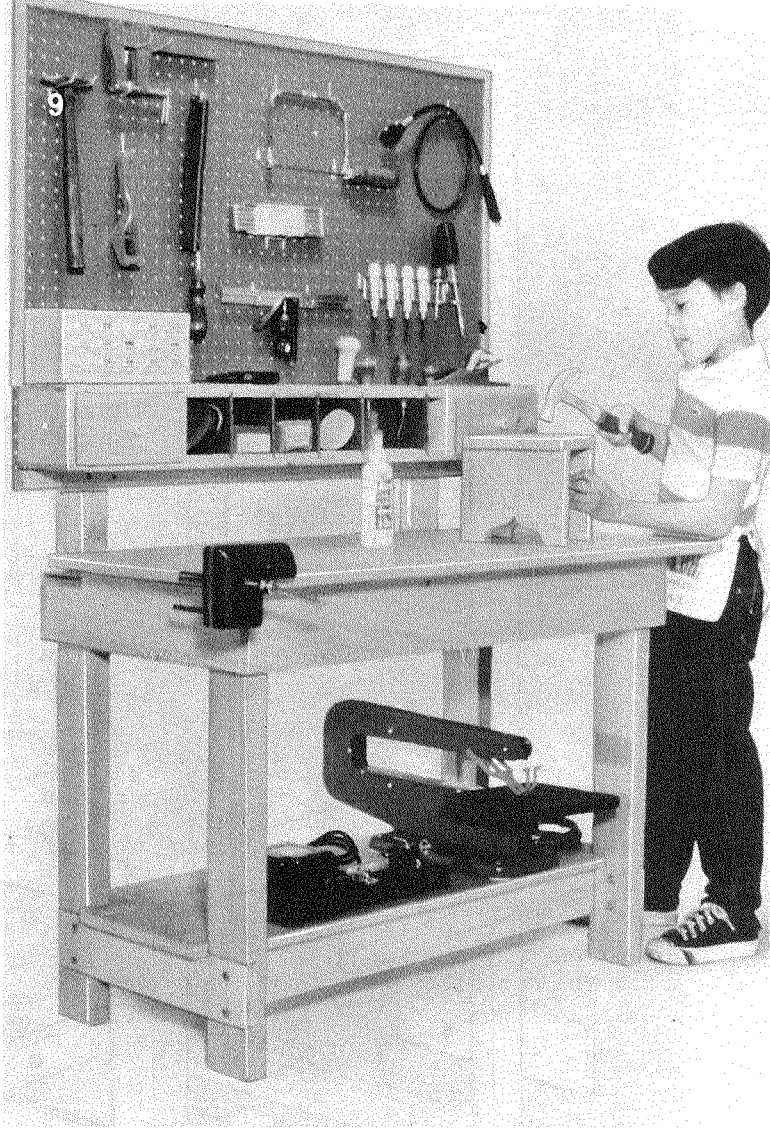
building Pop's bench

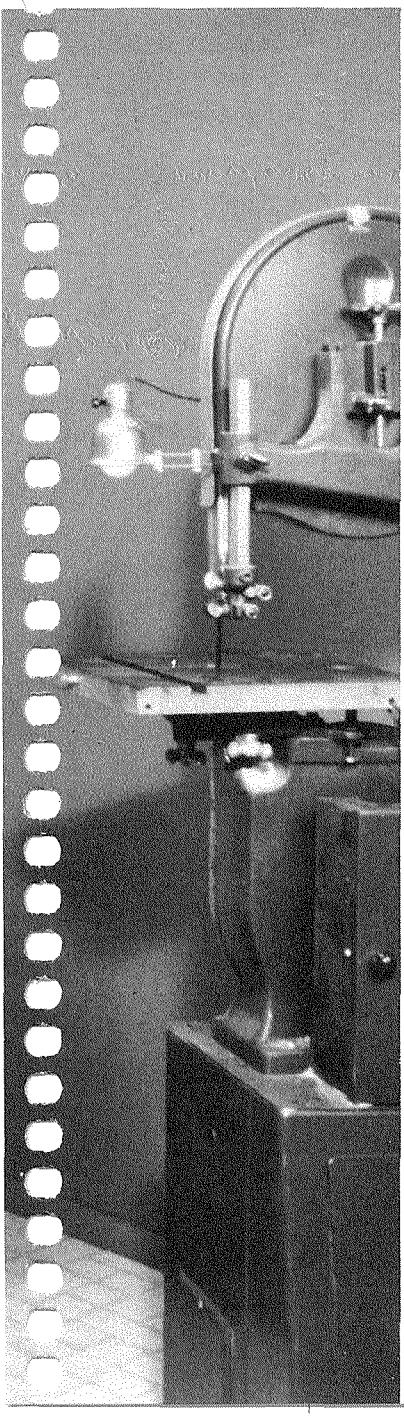
The bench vise hardware—No. 17D03-AW—is available from Woodcraft Supply Corp., 313 Montvale Ave., Woburn, MA 01801. Priced at about $70; it consists of two parts, the plate and handle assembly. A piece of 2 x 6 is used to provide a surface for securing the plate.



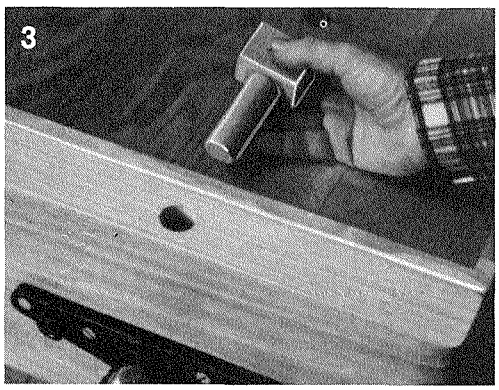


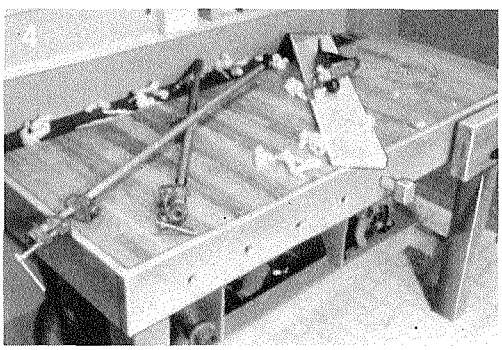


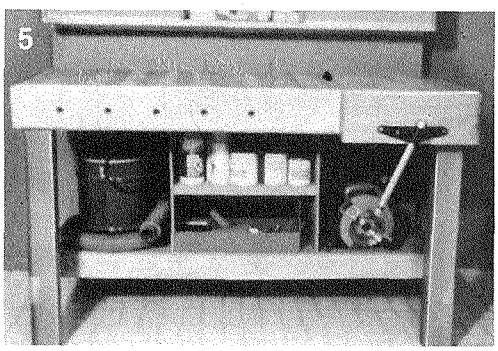


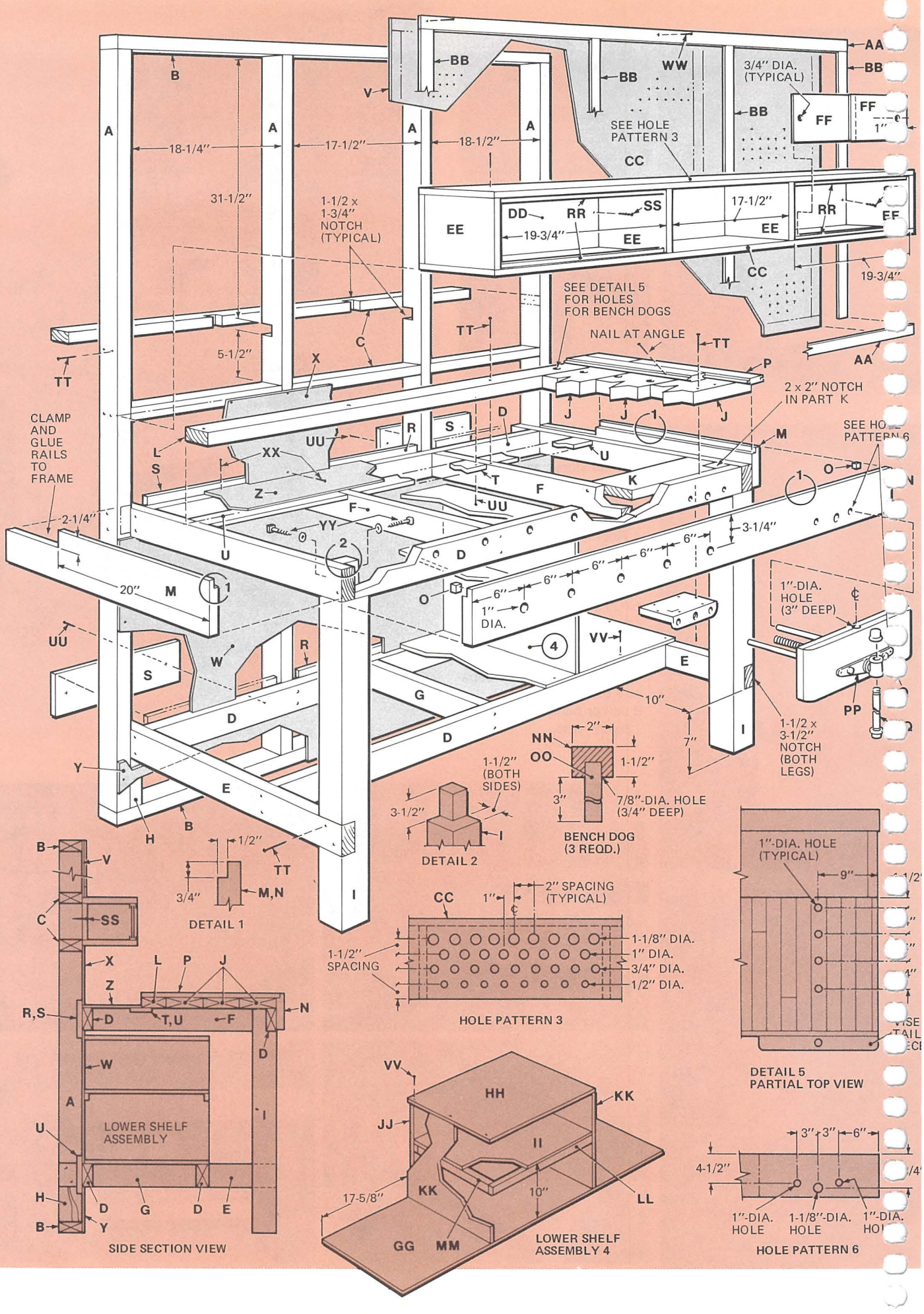


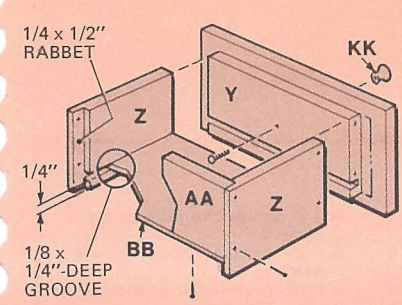
1 Pop's bench is rugged, easy to build.
2 Shelf stores small items conveniently.
3 Vise stop allows top-of-bench work-holding.
4 Roomy top is made of oak strip flooring.
5 There's ample storage below for large items.
6 Kid's bench sports a small, portable vise.
7 A shelf unit like Pop's features two drawers.
8 Hardboard dividers separate tools on shelf.
9 Junior bench suits 8- to 12-year-olds.



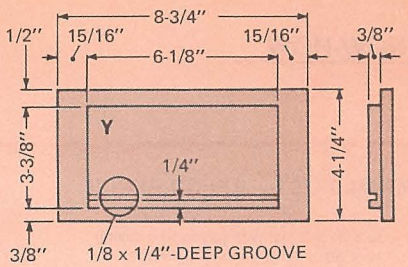




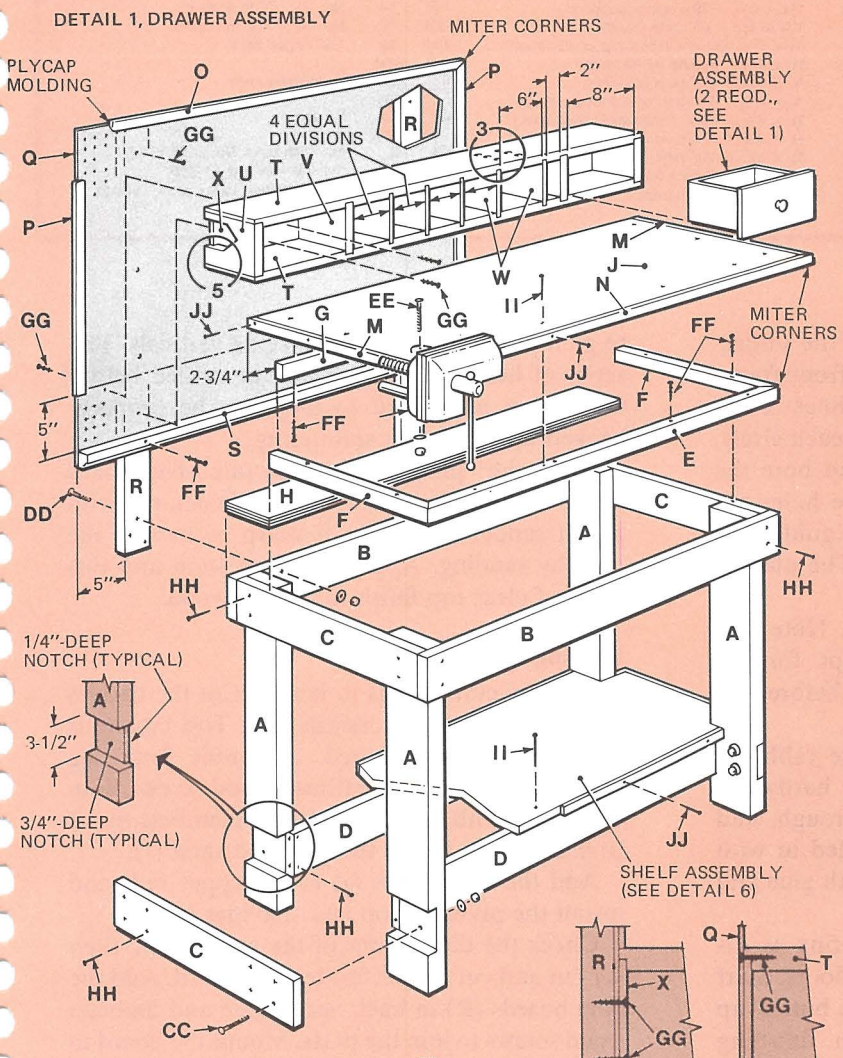

B
A
18-1/4"
17-1/2"
18-1/2"
31-1/2"
5-1/2"
V
BB
WW
AA
3/4" DIA. (TYPICAL)
FF
1"
SEE HOLE PATTERN 3
CC
1-1/2 x 1-3/4" NOTCH (TYPICAL)
EE
DD
RR
SS
17-1/2"
19-3/4"
TT
C
X
SEE DETAIL 5 FOR HOLES FOR BENCH DOGS
NAIL AT ANGLE
P
2 x 2" NOTCH IN PART K
CLAMP AND GLUE RAILS TO FRAME
L
S
XX
UU
R
D
J
M
SEE HOLE PATTERN 6
O
N
Z
F
YY
T
K
U
2-1/4"
20"
3-1/4"
6"
1"-DIA. HOLE (3" DEEP)
PP
W
G
E
10"
7"
1-1/2 x 3-1/2" NOTCH (BOTH LEGS)
Y
H
I
NN
OO
2"
1-1/2"
3"
7/8"-DIA. HOLE (3/4" DEEP)
BENCH DOG (3 REQD.)
1-1/2" (BOTH SIDES)
3-1/2"
DETAIL 2
1/2"
3/4"
M,N
DETAIL 1
SS
R,S
T,U
LOWER SHELF ASSEMBLY
2" SPACING (TYPICAL)
1-1/8" DIA.
1" DIA.
3/4" DIA.
1/2" DIA.
1-1/2" SPACING
HOLE PATTERN 3
1"-DIA. HOLE (TYPICAL)
9"
DETAIL 5 PARTIAL TOP VIEW
SIDE SECTION VIEW
VV
HH
KK
JJ
II
LL
17-5/8"
GG
MM
LOWER SHELF ASSEMBLY 4
3"
4-1/2"
1"-DIA. HOLE
1-1/8"-DIA. HOLE
HOLE PATTERN 6

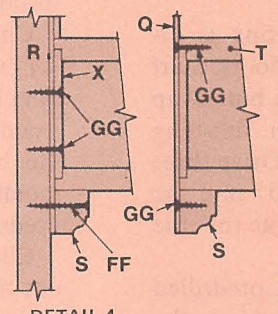


DETAIL 1, DRAWER ASSEMBLY

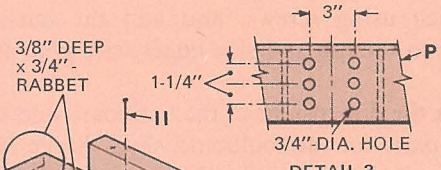


DETAIL 2, DRAWER FRONT Y

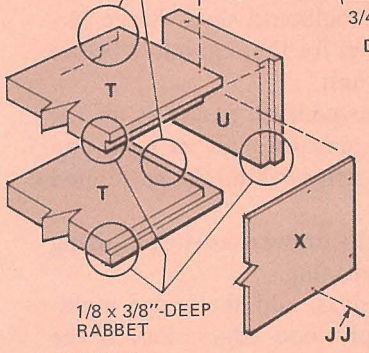




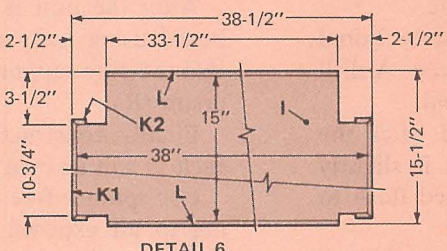
DETAIL 4, CABINET ATTACHMENT



DETAIL 3



DETAIL 5, CABINET UNIT, REAR VIEW



DETAIL 6, SHELF ASSEMBLY

MATERIALS LIST—DAD'S WORKBENCH

Key	No.	Size and description (use)
A	4	1½ × 3½ × 81" fir
B	2	1½ × 3½ × 60" fir
C	2	1½ × 3½ × 57" fir
D	4	1½ × 3½ × 54" fir
E	2	1½ × 3½ × 32½" fir
F	2	1½ × 3½ × 26" fir
G	1	1½ × 3½ × 16" fir
H	2	1½ × 3½ × 5½" fir
I	2	3½ × 3½ × 33¾" cedar (leg)
J	3	1½ × 5½ × 57" fir (subtop)
K	1	1½ × 5½ × 16¾" fir (vise mount)
L	1	1½ × 3½ × 57" fir (subtop)
M	2	1⅛ × 5⅜ × 29" pine (side rail)
N	1	1⅛ × 5⅜ × 59¼" pine (apron)
O	2	½ × ½ × ¾" pine (filler block)
P	as reqd.	¾ × 2¼ × 20½" red oak flooring (top)
Q	1	2 × 6¼ × 18" poplar, glued-up nominal 1" stock (vise tailpiece)
R	2	¾ × 5½ × 17" pine (nailing strips)
S	4	¾ × 5½ × 16¼" pine (nailing strips)
T	1	¾ × 3½ × 17" pine (nailing strip)
U	2	¾ × 3½ × 16¼" pine (nailing strips)
V	1	⅛ × 33¾ × 60" perforated hardboard (backing)
W	1	⅛ × 19¾ × 60" hardboard (backing)
X	1	⅛ × 9⅜ × 60" hardboard (backing)
Y	1	⅛ × 7 × 60" hardboard (backing)
Z	1	⅛ × 9 × 57" hardboard (countertop)
AA	2	¼ × 1½ × 60" fir (trim)
BB	4	¼ × 1½ × 30¾" fir (trim)
CC	2	¾ × 8 × 60" pine
DD	1	¾ × 5½ × 60" pine
EE	4	¾ × 5½ × 7½" pine
FF	4	⅛ × 5 × 10¼" hardboard (upper-shelf doors)
GG	1	⅜ × 18¾ × 57" plywood
HH	1	⅜ × 18¾ × 21¾" plywood
II	1	⅜ × 18⅜ × 21" plywood
JJ	1	⅜ × 18¼ × 21" plywood
KK	2	⅜ × 18¼ × 18¾" plywood
LL	2	½ × ¾ × 21" pine
MM	2	½ × ¾ × 17⅜" pine
NN	3	1½ × 1½ × 2" pine (bench dog top)
OO	3	⅞"-dia. × 3¾" dowel (bench dog shaft)
PP	1	Woodcraft vise, Model No. 17D03 AW
QQ	1	¾ × 14" (or to suit) pipe with 2 end caps (vise handle)
RR	2 sets	19¾"-length aluminum sliding-door track
SS	4	No. 14 × 2" fh screws
TT	as reqd.	10d common nails
UU	as reqd.	6d common nails
VV	as reqd.	6d finishing nails
WW	as reqd.	4d finishing nails
XX	as reqd.	¾" galvanized brads
YY	4	⅜ × 3½" lagscrews and washers

Misc.: White glue.

turn the page

MATERIALS LIST—JUNIOR BENCH

Key	No.	Size and description (use)
A	4	1½ × 3½ × 27¼" fir (legs)
B	2	¾ × 3½ × 38" pine (aprons)
C	4	¾ × 3½ × 17¾" pine (rails)
D	2	¾ × 3½ × 35" pine (stretchers)
E	1	¾ × 1½ × 38" pine (filler strip)
F	2	¾ × 1½ × 15" pine (filler strips)
G	1	¾ × 1½ × 36½" pine (filler strip)
H	1	¾ × 4¼ × 38" plywood (shavings trough)
I	1	¾ × 15 × 38" plywood (shelf)
J	1	¾ × 17¾ × 42½" plywood (counter)
K-1	2	¼ × ¾ × 11¼" pine (shelf edge strips)
K-2	4	¼ × ¾ × 1" pine (shelf edge strips)
L	2	¼ × ¾ × 33½" pine (shelf edge strips)
M	2	¼ × ¾ × 18" pine (shelf edge strips)
N	1	¼ × ¾ × 43" pine (shelf edge strip)
O	1	¼ × ¾ × 43" pine (plywood molding)
P	2	¼ × ¾ × 23¾" pine (plywood molding)
Q	1	⅛ × 30 × 42¾" perforated hardboard (toolboard)
R	2	1⅛ × 2½ × 39¼" pine (supports)
S	1	1⅛ × 1⅜ × 43" pine (cleat)
T	2	¾ × 5 × 43" pine (shelf top and bottom)
U	2	¾ × 4¼ × 5" pine (shelf ends)
V	2	¾ × 4¼ × 4¾" pine (dividers)
W	5	¼ × 4¼ × 4¾" hardboard (separators)
X	1	¼ × 4¼ × 42¼" hardboard (shelf back)
Y	2	¾ × 4¼ × 8¾" pine (drawer fronts)
Z	4	½ × 3⅜ × 4⅝" pine (drawer sides)
AA	2	½ × 3 × 7⅜" pine (drawer backs)
BB	2	⅛ × 4⅝ × 7⅜" hardboard (drawer bottoms)
CC	8	¼ × 2" carriage bolts with nuts and washers
DD	6	¼ × 2½" carriage bolts with nuts and washers
EE	3	¼ × 1½" fh bolts with nuts and washers
FF	14	No. 10 × 2" fh screws
GG	18	No. 10 × 1¼" fh screws
HH	as reqd.	1¼" ringed nails
II	as reqd.	2" finishing nails
JJ	as reqd.	¾" brads
KK	2	Amerock pulls, No. BP-705-30
LL	1	Stanley vise, No. 81-700

Misc.: White glue, sandpaper, Latex paint, varnish.

Hold the plate in position against the underside of the 2 x 6 and the rear of the front frame member of the bench. Trace the outlines of the three holes; then mark the centers of each circle. Transfer these marks to the front and bore the holes for the handle assembly. These holes are drilled larger than the diameter of the guide rods and vise screw to prevent bindings. The plate is secured with flathead wood screws.

The 2 x 6 subtop is now nailed in. Note that the last plank receives nailing strips for the trough panel. These are attached before the plank.

The bench front and side rails are rabbeted along their top edges to receive the hardwood top. The rabbet is cut completely through, and the gaps resulting at the ends are filled in with small blocks. The rails are secured with glue and nails.

Tongue-and-groove oak strip flooring is installed in the same manner as it is on floors. Start at the right end with the groove edge butted up against the side rail. Drive three 2-in. finishing nails about ¾ in. from the lead edge. Drive three flooring nails at an angle of about 45° into the tongue. Pilot holes bored into the tongue (not the base) will prevent splitting.

Finishing nails are driven through predrilled holes in the top surface on the last strip (as on the first one). In order to fit the last strip in place, you must cut a slight bevel on the last edge.

The holes for the bench dogs must be bored perfectly perpendicular to the bench top. A drill guide such as the Portalign tool is ideal.

The wooden vise tail is attached after the bench top has been completed. Cut it slightly oversize at the top so it can be planed flush to bench top after installation.

The cabinet/shelf is constructed as a separate unit and attached with screws driven at an angle to gain purchase in the rear-frame verticals. The series of holes for tools should be drilled before the unit is assembled so they can be properly backed up to prevent splintering.

Add the plain and perforated-hardboard panels and border trim. Sand the bench top with a belt sander and ease all sharp corners of the rails by sanding. Apply a coat of stain and two coats of clear top finish to all raw wood.

building Junior's bench

Start by cutting legs to length. Cut the dadoes to receive bottom crossrails (C). Top crossrails (C) are surface-mounted. Assemble both leg panels using glue and flathead wood screws. Join leg panels with remaining frame members, parts B and D; then install the plywood shelf (I).

Add the filler strips (J) to the upper rails and install the plywood top and shavings trough.

Check the dimensions of the workbench; then lay out and cut the perforated toolboard. Add the pine boards (R) in back, using glue and flathead wood screws to join the parts. Mount the board to the bench using screws, and add the outside molding to the top and side edges with glue and brads.

Check the dimensions of the toolboard and lay out the parts for the toolboard shelf. Make certain you cut the dadoes for the separators before assembling the shelf unit.

After the unit is assembled, install it on the board using hefty screws through its back and into the pine support strips behind the perforated board (R).

Finally, construct the drawers as shown, sizing each to suit its own opening.

For splinter-free edges, add shelf-edge molding to all exposed plywood edges. Fasten the moldings with glue and countersunk brads. Sand the entire piece and finish if desired.

How water gets into your basement—and how to stop it

A chronically wet basement can be one of the toughest problems for a homeowner—or professional—to diagnose. Here we prescribe the cures

By JOHN H. INGERSOLL

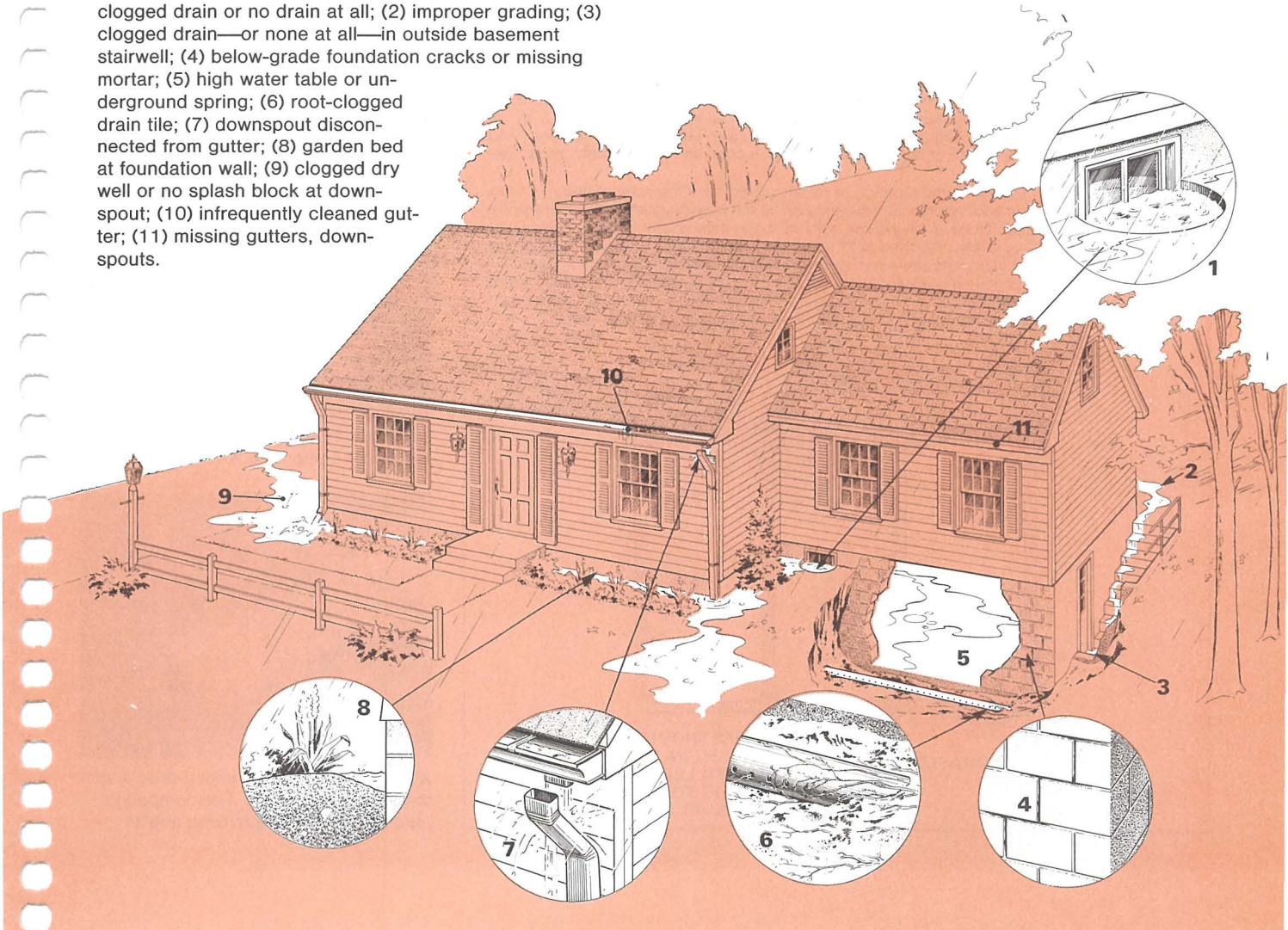
■ ANYONE who has pumped out and mopped up a basement flood knows the hopeless feeling it generates and the damage water leaves in its wake. Out-of-season clothes, shoes, books, dry firewood, golf clubs, oil-pump motors—all suffer from a forced bath.

Listed below are 11 common situations which potentially lead to a wet basement. Find those cases which resemble your own and read what you can do about them.

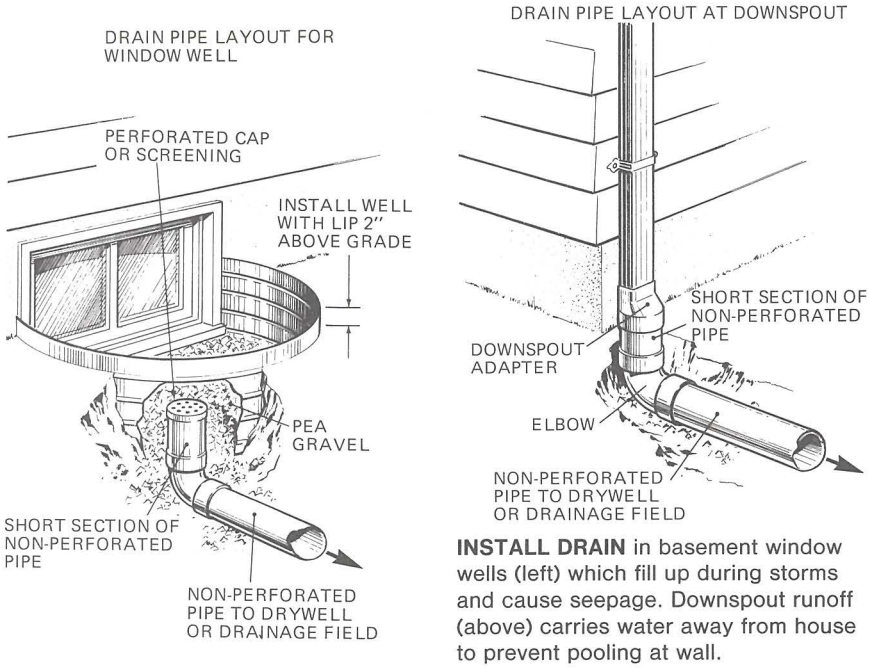
1. Seepage from basement window wells occurs when rainwater collects in the wells and enters through cracks around the window or through the foundation itself.

Cures: Build up the curb around a window-well perimeter with masonry or corrugated metal. Where no drain exists, install one attached to piping leading away from the foundation as shown on page 96.

THERE ARE many causes of a wet basement; 11 of the most common are: (1) basement window wells with clogged drain or no drain at all; (2) improper grading; (3) clogged drain—or none at all—in outside basement stairwell; (4) below-grade foundation cracks or missing mortar; (5) high water table or underground spring; (6) root-clogged drain tile; (7) downspout disconnected from gutter; (8) garden bed at foundation wall; (9) clogged dry well or no splash block at downspout; (10) infrequently cleaned gutter; (11) missing gutters, downspouts.



SIMPLE DRAINS FOR COMMON PROBLEMS


DRAIN PIPE LAYOUT FOR WINDOW WELL
PERFORATED CAP OR SCREENING
INSTALL WELL WITH LIP 2" ABOVE GRADE
PEA GRAVEL
SHORT SECTION OF NON-PERFORATED PIPE
NON-PERFORATED PIPE TO DRYWELL OR DRAINAGE FIELD
DRAIN PIPE LAYOUT AT DOWNSPOUT
SHORT SECTION OF NON-PERFORATED PIPE
DOWNSPOUT ADAPTER
ELBOW
NON-PERFORATED PIPE TO DRYWELL OR DRAINAGE FIELD

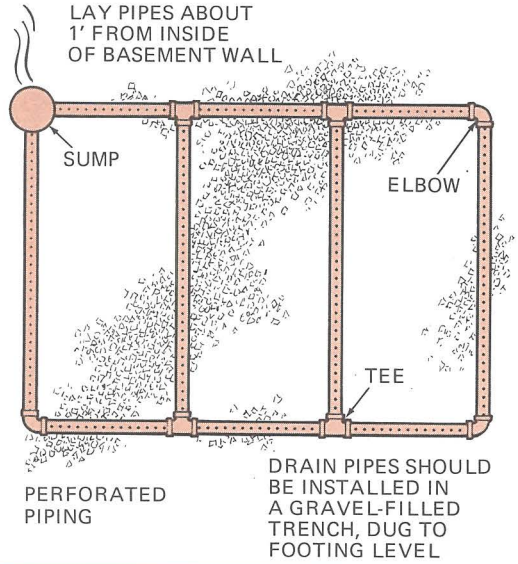
INSTALL DRAIN in basement window wells (left) which fill up during storms and cause seepage. Downspout runoff (above) carries water away from house to prevent pooling at wall.

IF ALL ELSE FAILS . . .

When all efforts at stemming basement leaks have failed, consider the use of a pressure-relief system. If you're really ambitious you may attempt to do it yourself. Use a cold chisel and hand sledge (the long hard way) or a rented jackhammer to break open a 12-in.-wide trench around the perimeter of the basement floor. Once through the slab, dig and remove soil to a depth of at least 12 in. If the trenches slope at all, the drop should be toward the sump. Level trenches, however, are adequate. Fill 1-ft.-deep trenches with 2 in. of crushed stone, continuous 4-in. perforated plastic pipe (with elbows at the corners), and then add more stone to the floor level. Leave the trench open and form a slight swale (depression) at its center.

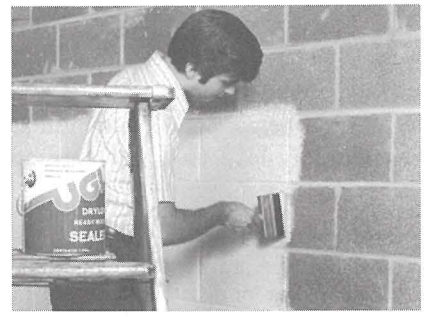
For floors which persist in puddling up, or for those with existing sump pumps that are located away from the wall, additional trenches can be cut (see diagram). Lay in the same stone/perforated pipe/stone combination, attaching the pipe to the perimeter sections with tees. Then cover these trenches with fresh concrete so that you have use of the basement floor again. Covering the perimeter trenches is an option to consider.

If you don't already have a quality sump pump, you should purchase and install such a unit. Lead the evacuating pipe to an area drain, a dry well that's located at least 25 ft. away from the house, or to an open outfall on the downhill side of your property.

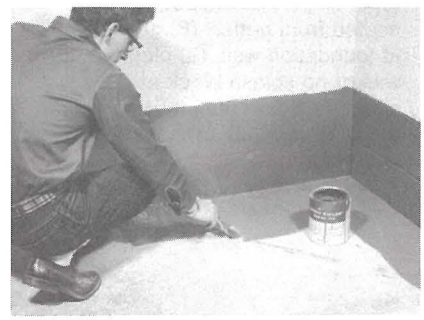

LAY PIPES ABOUT 1' FROM INSIDE OF BASEMENT WALL
SUMP
ELBOW
TEE
PERFORATED PIPING
DRAIN PIPES SHOULD BE INSTALLED IN A GRAVEL-FILLED TRENCH, DUG TO FOOTING LEVEL

HOW TO SEAL YOUR BASEMENT WALLS FROM THE INSIDE

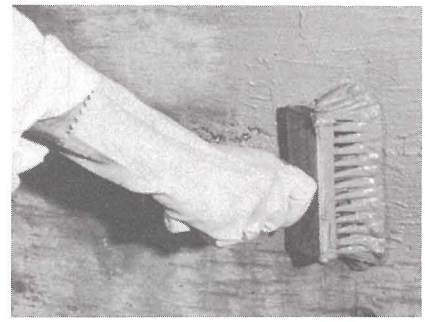
BEFORE APPLYING sealer, use wire brush to remove loose debris; then plug all holes and seams with patchng mix.



APPLY single-coat, Portland-cement-type sealers with a stiff brush to get the granules into the masonry pores.



SPREAD two-part epoxy sealer with a polyester brush. Mix only what you can handle or compound will begin to set.



XYPEX SEALER is brushed onto a wall that has been wetted. The compound penetrates concrete to form a seal.

2. Poor grading around the foundation accounts for most basement water problems. Faulty grading is described as any soil condition that dumps water against a foundation wall. The water eventually builds enough pressure—called hydrostatic pressure—so that no matter how well foundation walls are protected against seepage, it will find a way in.

The commonest form of poor grading is ground leading away from the house on the level, or worse, inclined uphill. These situations are not too hard to correct. The toughest problem occurs when a builder fails to provide ground-water drainage for a house built into a hillside or he digs a swale (depression) at the base of the hill, but underestimates the amount and force of water coursing down the hill toward the house.

Cures: Raise the grade around the foundation so that a fall of at least ½ in. to the foot continues down and away from the house at least 6 ft., and preferably 10. With fresh mortar, parge bare masonry around the foundation before packing new soil against it, or adhere a layer of 6-mil black polyethylene to the masonry surface. Over the new soil, plant a thirsty ground cover, such as pachysandra, vinca minor or periwinkle—or put down sod.

For the hillside house at the foot of a virtual waterfall during a rainstorm, the cure takes more time and energy. Redirect water around the house and downhill by a French drain—a ditch filled with crushed stone. This water-absorbing ditch parallels the line where hill and level lot meet.

Viewed from a helicopter, the drain looks like a U around the house, its base on the uphill side. Depth and width of the ditch will vary. Cover the stone-filled trench with straw, topsoil and sod. At the line below the hill, sod cover should be at the center of a slight swale, so hill-draining water has a chance to soak into the French drain.

As added insurance to catch a large volume of water, lay drain pipe over 2 in. of stone at the base of the ditch before backfilling with the remaining stone.

At lower ends of the drain lines, divert outfalling water with rock so the current doesn't carve furrows in the lawn. Or, connect the drains to solid piping that carries water underground to drainage.

3. Exterior basement entries are often water routes to basements. You may have too low a curb around your stairwell opening, a clogged drain, or may lack a drain in the stairwell. Double metal cellar doors that have been climbed upon or banged with a heavy object may have damaged runoff channels that direct water into the basement.

Cures: Same as for No. 1. Use caulking to seal around metal cellar doors. Bend deformed channels back in position if possible.

4. Cracks in masonry or at masonry joints are a common cause of water infiltration. Masonry that is porous and subjected to ground-water pressure is also a sure candidate.

Cures: If you have eliminated water against the foundation wall as much as possible and still have moisture or seepage, consider applying an interior masonry sealer. A comparison of three types appears in the chart on page 98. Follow manufacturer's directions for wall preparations to the letter.

5. A high water table or an underground spring are the rarest sources of basement floods, and are most difficult to stop. If water in your basement is essentially clear, it probably flows from one of these sources.

Cures: The pressure-relief system described on page 96 should handle the problem.

6. Clogged drain tile around the foundation footing forces ground water against the foundation or beneath the footing into the space below the floor slab. Old clay drain tile laid in sections is usually to blame. Silt and soil build up between sections that have worked apart. A tree root may have broken through a tile (and could do the same to newer plastic drain piping).

Diagnosing this problem is difficult; the only sure way is to dig down, unearth the tile and examine it. That's time-consuming, and should you have it done, expensive. A simple test, however, tells you the direction from which water comes. If water lying on the basement floor is muddy or laced with silt, it's a 99-to-1 bet it came from the ground around the foundation, and just possibly seeped into the basement because of blocked drain tile. Clear water usually indicates a spring or high water table.

Cure: Double check water sources through 3. If you can divert ground water from the drain tile, whether the tile is blocked or not becomes irrelevant.

Having completed your checking and correcting only to discover during the next downpour that the basement still leaks, proceed to the next least-expensive step: Seal the basement walls, the periphery of the floor.

In the unlikely event your basement still leaks, review your latest work. Have you missed anything? Skimped on application? If not, you need the pressure-relief system.

BASEMENT WALL AND FLOOR SEALERS

Material	Before Applying, Fill Holes and Cracks With	Apply Over Paint?	Apply Over Wet Wall?	Coverage	Masonry Penetration	Recommended Number of Coats	Warranty	Paint Over It?	Approx. Cost (1600) sq. ft.)
Drylok (Portland cement plus additives, i.e. synthetic rubber)	Hydraulic cement	Only over a cement-base paint in good condition	No, but okay over damp wall	75 to 100 sq. ft. per gallon	Deeper than paint	2	Five years when applied correctly	Yes	$210
Devcon (Two-component epoxy compound)	Hydraulic cement or Portland cement mortar	Only if paint condition is very good	No, but okay over damp wall	150 to 200 sq. ft. per gallon	Forms tough outer coating	2	None	Yes	$350
Xypex (Portland cement, silica, organic chemicals)	Thicker mix of Xypex	No	Yes; will not work otherwise	6 sq. ft. per gallon	Several coats, thickness of foundation wall	2	Warranty by applicator who does job	Yes	$385

WHERE TO GET PROFESSIONAL HELP

If you decide that you need outside help, call in a professional for a diagnosis and estimate. But be wary. Over the years, basement waterproofing has been a profit bonanza for gyp artists. One of their favorite gambits is to convince an owner they will waterproof the outside of a basement wall without digging up a spoonful of soil. How? By inserting a hose into the ground at intervals along the foundation and pumping in a surefire formula that is meant to spread and seal the masonry successfully.

"Absolute nonsense," says the president of the oldest waterproofing company in New York City, a company engaged in sealing commercial buildings, tunnels and bridge supports.

The technique was originally based on a passable idea: pumping bentonite into the soil around a basement. Bentonite is a claylike substance derived from volcanic ash. As the material absorbs water, it expands. In the soil, bentonite is intended to draw off ground water aimed at the foundation wall, and simultaneously expand, in theory, pressing dry backfill against the foundation wall.

In practice, the bentonite scheme failed enough times to give the method a shaky reputation. And more than a few owners learned later to their dismay that the formula injected around their house wasn't even bentonite, but a cheap, worthless imitation of the clay-like substance.

But don't give up. There are reputable contractors. Find one the way you would locate any professional—by asking friends for recommendations, then checking out the contractor's stated reputation. A good place to start looking? Call the nearest chapter of the National Home Improvement Council. Or write the national office of NHIC at 11 East 44th St., New York, NY 10017.

7. Broken or rusted-out downspouts and gutters that fail to carry off water are obvious trouble sources.

Cure: By all means, repair breaks and replace rusted-out sections of the rain-carrying system. Often, the weak point is the right-angle gutter beneath a roof valley. During a hard rain, valleys can catch and send more water coursing than a gutter will carry. If possible, cut a downspout into the system at the angle, and divert the outflow.

8. Flower beds parallel to the foundation are a form of poor grading that can also lead to water where you don't want it. Gardens crested in the center are the worst offenders—they invite water to pool and seep along the foundation wall.

Cure: Get rid of the garden. Build up the grade as noted in No. 2, and plant ground cover or lay down sod.

9. A downspout that pours water only a few inches from the foundation wall is little help. It may cause the soil to become saturated (boggy) with water, thereby increasing the likelihood of basement seepage. A stopped-up or flooded dry well close to the house produces the same effect.

Cures: At least, put a stone or concrete splash block under the downspout. Better, attach a rolled vinyl hose to the downspout end. Force of the flow unrolls the hose and deposits water some distance away from the foundation.

Best of all, connect the downspout with solid piping leading to an area drain, or a dry well excavated at least 25 ft. from the foundation. (A dry well is 6 to 8 ft. deep, 4 to 6 ft. in diameter, and walled with unmortared stone or concrete block. The top is closed with a stone slab or cast concrete lid. Then covered with a layer of topsoil and sod to match the lawn.)

10. Clogged gutters resemble Nos. 7, 8 and 9 in their damaging effect. They are, however, a lot easier to remedy.

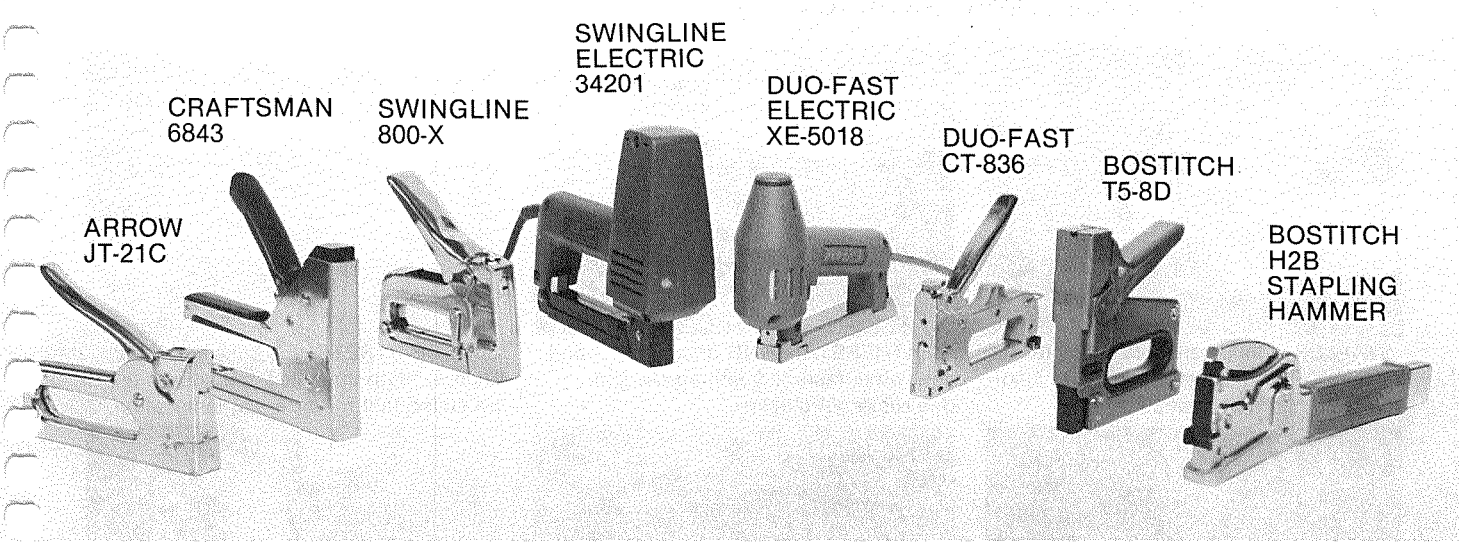
Cure: Climb to the roof and, using a garden trowel or gloved hand, scoop gutter-muck into a bucket or to the ground. Install "bird-cages" or screening at top openings of all your downspouts to prevent the possibility of clogging with twigs and leaves.

11. The lack of gutters and leaders can cause ground beneath the eaves to erode. During a rain, the depressions fill with water that eventually will find its way inside your basement.

Cure: Install a rain-carrying system.

SEALER MANUFACTURERS

Devcon Corp. (Devcon Epoxy Sealer) 61 Endicott St., Danvers, MA 61923
United Gilsonite Laboratories (Drylok Ready-mixed Sealer), Scranton, PA 18501
Xypex Chemicals Ltd. (Xypex) 12520 Vickers Way, Richmond, BC V6V 1H9



How to buy and use a staple gun

By ROSARIO CAPOTOSTO

■ IF YOUR TOOL KIT doesn't include a staple gun, you're missing out on a great way to do numerous fastening jobs around the home and shop. This tool has definite advantages over nails and hammer for certain jobs, and is indispensable for many others.

Speed and convenience are the main advantages of the staple gun. It requires only one hand to operate and can drive three or more staples in the time it takes to hammer one nail. Also, staples are less expensive than brads or nails. With the two legs connected by the crown, they have as much (or greater) holding power as nails several times their thickness.

There are three basic types of staplers for general use: spring-drive manual, electric and hammer, but the widest variety is found among the spring-drive tools.

The spring drive units come in light- and heavy-duty versions and, in some makes, dual or variable power. Staples, measured in leg lengths, are available in sizes from 3/16 to 9/16 in. Light-duty models usually drive 3/16- to 5/16-in. staples, whereas the heavy-duty guns will drive all sizes.

For jobs such as decorating with paper and cloth, fastening insulation, screening, plastic sheeting and light upholstery, a light-duty gun is adequate. Heavier chores, including the fastening of ceiling tiles, fencing, wall paneling or light wood construction call for a heavy-duty tool.

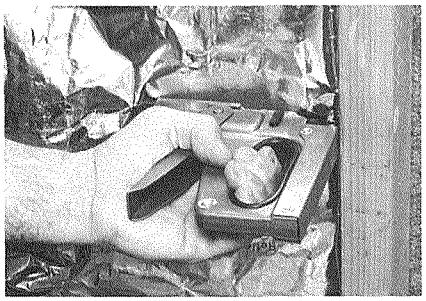
For the ultimate in efficiency and ease of operation, you should consider buying an electric staple gun. A light pressure on the trigger with your index finger will drive any size staple up to 9/16 in. completely into tough material, such as hard wood, as quickly as you please. The average cost of the electrics is about $30—a reasonable price for a tool that can make even the toughest of jobs, such as installing ceiling tiles, a pleasure.

The stapling hammer, as the name implies, is swung like a hammer, driving a staple with each blow. Fast and powerful, this tool is especially for rough work, such as applying building paper, roofing felt or insulation. Heavy-duty models are available for installing asphalt shingles with 3/4-in. staples. It is definitely not recommended for precision positioning of staples, however.

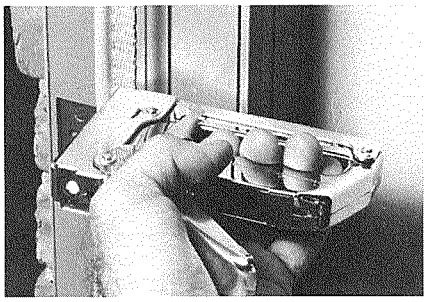
We put each tool shown to a relatively tough test to check penetration power. Shooting staples into a piece of 3/4-in. solid oak, we found that all of the spring-drive manuals, including the light-duty models, could drive 1/4-in. staples completely into this very hard and dense wood. The heavy-duty guns and the stapling hammer did as well with 3/8-in. staples. Full penetration with 1/2- and 9/16-in. staples was achieved only with the electrics.

Fastening ceiling tiles directly to gypsum wallboard or lath without furring strips requires a technique termed piggybacking. Since the nature of the material won't allow a staple to anchor adequately, drive a second staple directly over the

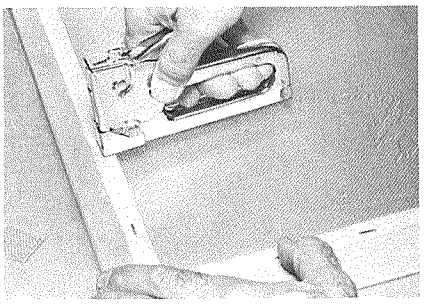
SIX HANDY WAYS TO USE A STAPLER AROUND THE HOUSE



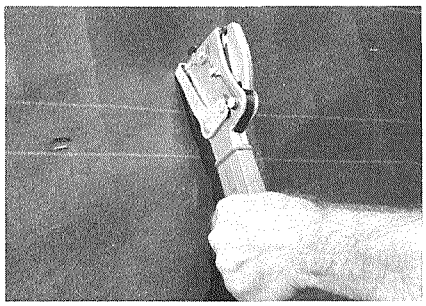
STAPLER is indispensable for installing insulation. Note: Fasten foil-faced insulation to allow air space.



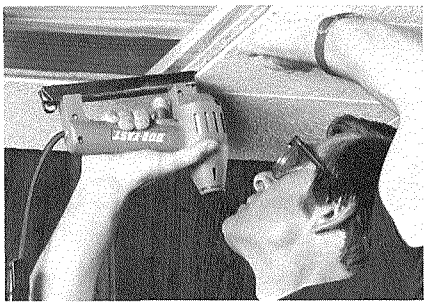
WEATHERSTRIPPING goes up fast and neat when fastened with staple gun. Use rustproof staples.



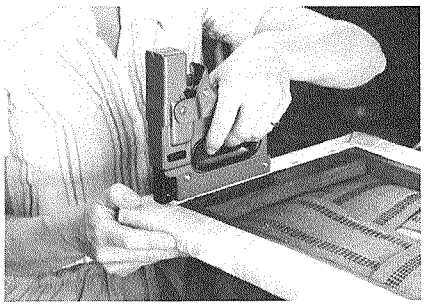
SCREEN-STRETCHER accessory has shallow teeth that allow the screen to be pulled taut for a no-sag installation.



BUILDING PAPER and saturated felt go up quickly with a stapling hammer. The tool is swung like a regular hammer.

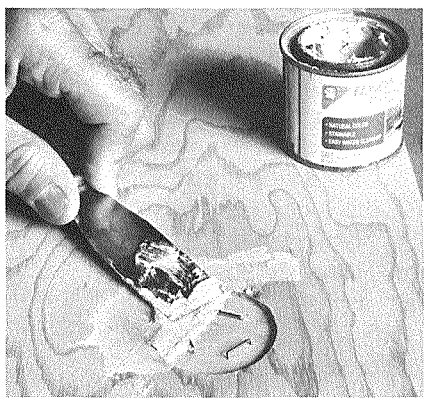


A LIGHT TOUCH on the trigger of an electric gun simplifies the otherwise difficult task of installing ceiling tiles.

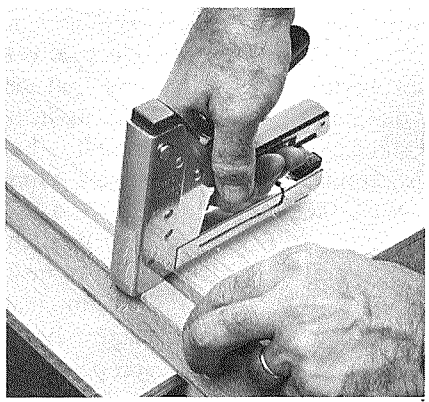


CHAIR SEATS may be recovered, repaired or rebuilt with a staple gun. Use it to attach webbing and padding cover.

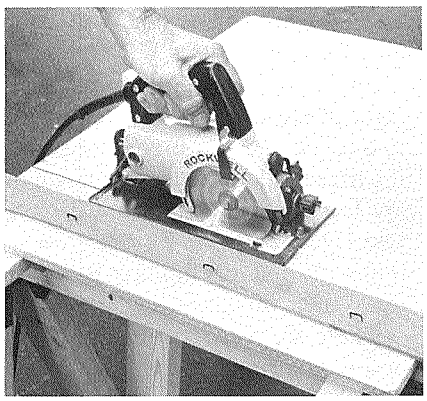
FOUR SHOP TASKS MADE EASY WITH A STAPLER



PARTIALLY DRIVEN staples can effectively serve as key that will help to lock wood filler in a shallow patch.

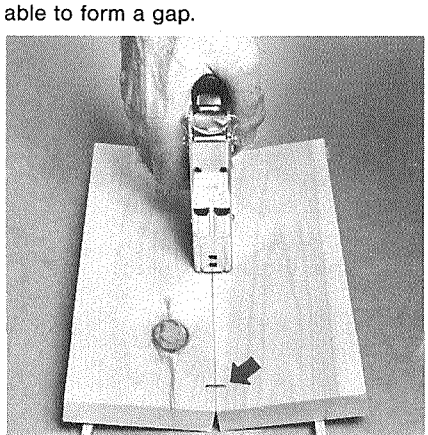


A STRIP of wood is used as a spacer to partially drive staples for temporary tacking of sawing guide.

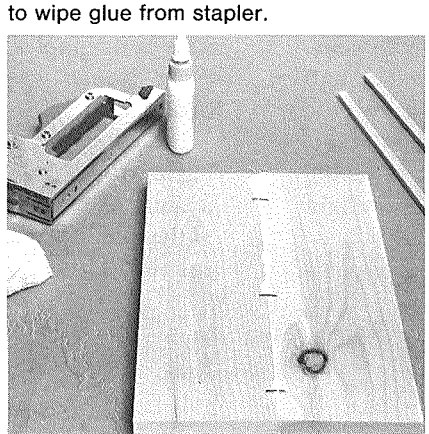


STRAIGHTEDGE guide is held firmly with a few staples that are easily removed. Holes in the work are negligible.

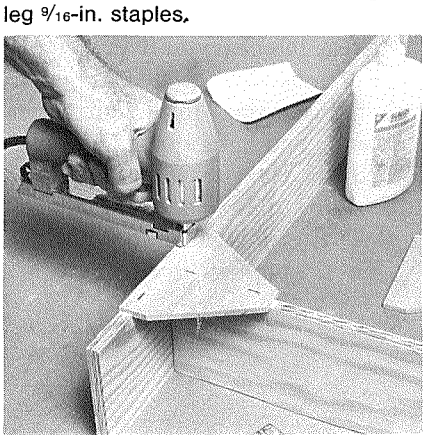
STAPLES serve as clamps for edge gluing. Boards are tilted so they are able to form a gap.



AFTER GLUING, gap is stapled closed to form a tight joint. Use a damp cloth to wipe glue from stapler.

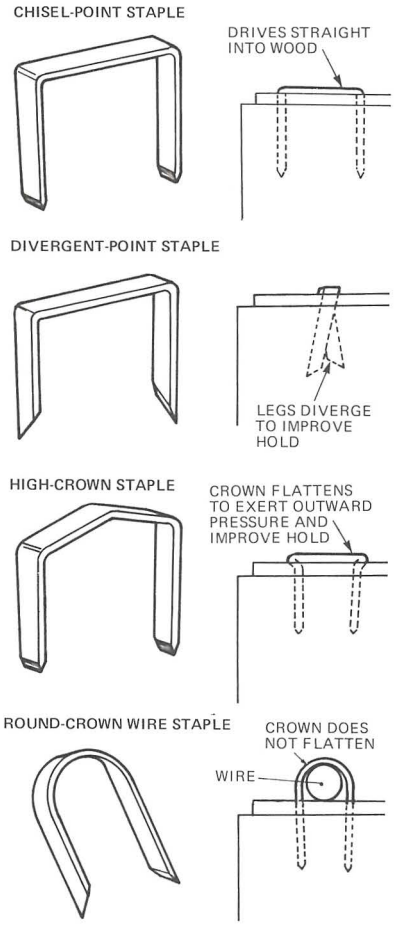


STAPLES simplify gluing reinforcing gussets in light assemblies. Use long-leg $9/16$-in. staples.



STAPLING GUNS FOR HOME AND SHOP

Make and Model	Staple Sizes (Inches)	Features	Suggested Price
Arrow T-50	¼, 5/16, ⅜, ½, 9/16	Heavy duty	$19.50
Arrow JT-21C	¼, 5/16	Light duty, built-in staple remover	11.00
Arrow T-18 (wire)	⅜ (round crown)	For wire up to ¼" dia.	29.00
Arrow ET-50 Electric	¼, 5/16, ⅜, ½, 9/16	Solid-state circuitry, safety trigger lock, plastic housing	31.50
Arrow HT-50A Hammer	¼, 5/16, ⅜, ½	Intermediate-duty stapling hammer	29.00
Bostitch T5-8D	3/16, ¼, 5/16, ⅜, ½, 9/16 (arched crown)	Heavy duty, crowned staples only	27.45
Bostitch T5K Kit	5/32, 3/16, ¼, 5/15, ⅜, ½, 9/16	Heavy duty, plastic carry case, 3000 staples	27.45
Bostitch T11K1	¼, 5/16	Light duty, 600 staples	9.75
Bostitch T5-80C Outward Clinch	⅜, ½, 9/16	Heavy duty, turns legs outward to lock under soft materials	27.45
Bostitch T5-8GL Gypsum	9/16	Heavy duty, for fastening ceiling tile directly to gypsumboard; drives two staples piggyback	23.45
Bostitch H2B Hammer	¼, ⅜	Light-duty stapling hammer	34.05
Craftsman 6843 Dual-compression Kit	¼, 5/16, ⅜, ½, 9/16	Heavy duty, extra power setting, screen stretcher, desk adapter, belt clip, 2000 staples, carry case	15.99
Craftsman 6848	5/16	Light duty	7.97
Duo-Fast CT-859A Variable Power	¼, 5/16, ⅜, ½, 9/16	Heavy duty, adjustable power for light work	22.50
Duo-Fast CT-836 Variable Power	¼, 5/16, ⅜	Light to medium duty, adjustable power	13.99
Duo-Fast XE-5018 Electric	¼, 5/16, ⅜, ½, 9/16	Heavy duty, solid-state circuitry, built-in screen stretcher, trigger lock, plastic housing	34.50
Swingline 101	¼, 5/16	Light duty, built-in staple extractor	10.45
Swingline 800X Kit	¼, 5/16, ⅜, ½, 9/16	Heavy duty, belt clip, 1600 staples, carry case	18.58
Swingline 1000	¼, 5/16, ⅜, ½, 9/16	Heavy duty, peep window tells when to reload and shows staple leg size	18.60
Swingline 34201 Electric	¼, 5/16, ⅜, ½, 9/16	Heavy duty, solid-state circuitry, trigger lock, plastic housing	29.95



STAPLES VARY according to the shape of their crown and legs (above right). The most common staple has a straight crown and chisel points on both legs. A staple with a high (arched) crown is designed to spread at the top on impact. The tension serves to create greater holding power. Staples with divergent (sawtooth) points are also designed for better holding power. Beveled in opposite directions, the points cause the legs to diverge slightly when driven, making them more resistant to pulling out. Staples made especially for ceiling-tile installation are cement- or resin-coated and usually have sawtooth points. This combination assures maximum holding power. *Note:* Staples fit only the stapler for which they are made.

first one. The legs of the second staple are deflected outward by the rounded corners of the first one, thus achieving a firm grip. The trick can be accomplished if the tool isn't moved between drives. A special staple gun that drives the two staples, one over the other, is available for the purpose.

A wire stapling attachment for conventional staplers is also available. Instead of utilizing round crown staples, it acts as a stand-off to prevent the staple from being driven in completely. It thereby bridges the wire, but should only be used in low-voltage installations.

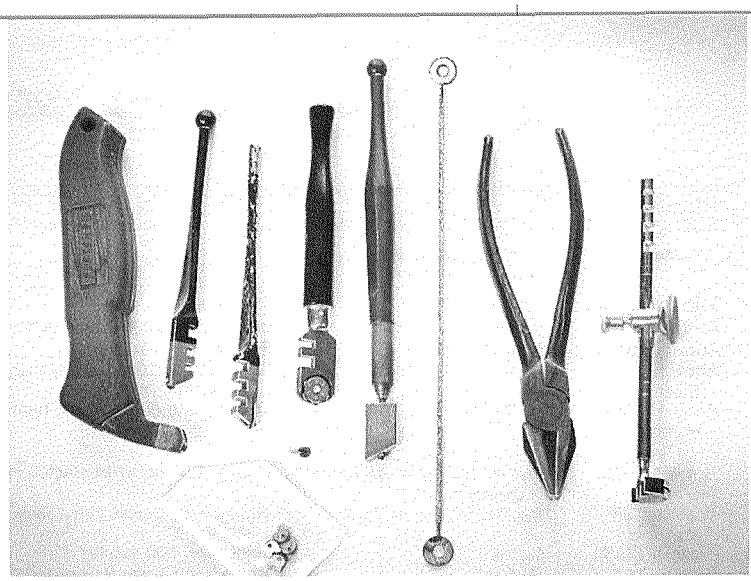
STAPLE SIZE GUIDE

¼"	5/16"	⅜"
Window screens	Light upholstery	Insulation
Shelf papers	Leatherette	Roofing paper
Closet linings	Cornice	Building paper
Window shades	Quilting	Weatherstripping
Draperies	Wall deco	Wire mesh
Artwork	Wall coverings	Needlework
Art canvas		Floor padding
½"	**9/16"**	
Carpeting	Lathing	Note: All makers offer rustproof staples in some sizes for outdoor use.
Underlayment	Wire fencing	
Felt stripping	Heavy upholstery	
Canvas and duck	Roof coverings	
Fiberglass	Heavy insulation	
LV electric wire	Ceiling tiles*	
	Light framing	

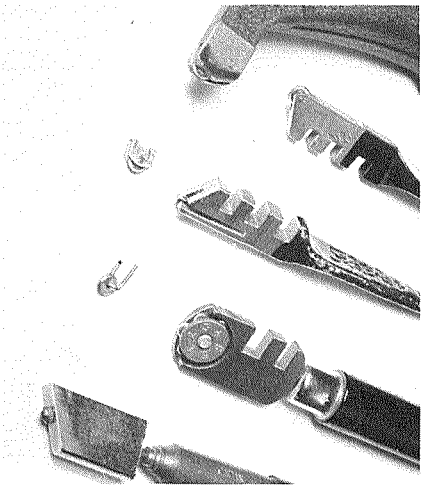
*Cement or resin-coated staples are required for the installation of ceiling tiles.

An expert's secrets for cutting glass

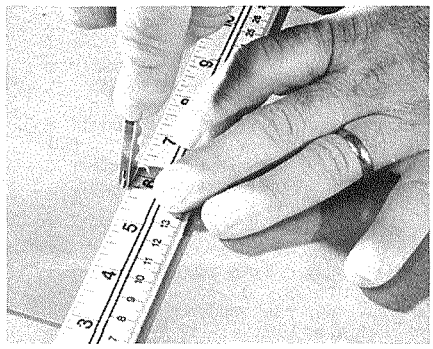
By OTHA C. SPENCER



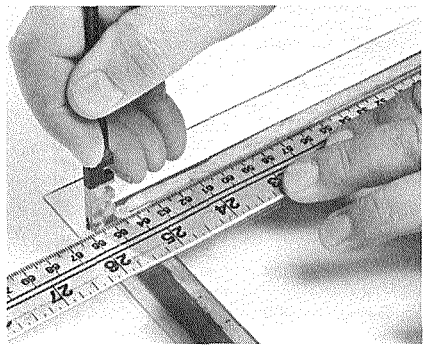
1 Glass-cutting tools available are (left to right): heavy-duty cutter with replaceable wheel; standard cutter with ball tip; standard cutter with replaceable wheel; multiple-head cutter; diamond cutter; glass-cutting hacksaw blade; glazier's pliers and circle cutter. You will also want safety goggles and glass-handler's gloves or other gloves that permit a good grip.



2 The cutting heads shown are (from the top): heavy-duty cutter; standard cutter; cutter with replaceable wheel; multiple-head cutter and diamond cutter.

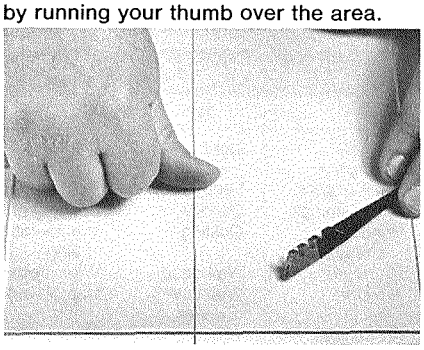


3 The cutting surface must be flat. The standard way to hold cutter is between index and middle finger. Keep the cutter perpendicular to glass.

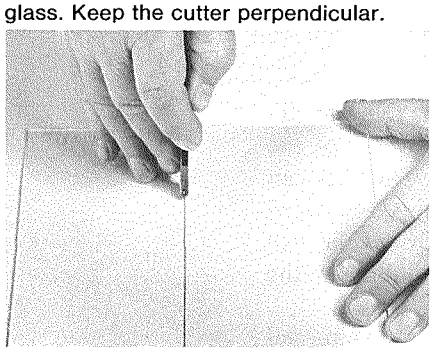


4 To get a good fit on a picture-frame glass, cut it over the frame. A straightedge with some strips of tape on the bottom is a good, nonskid guide.

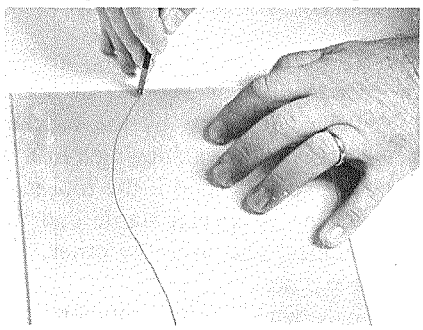
5 To get a good cut, the glass must be clean. After cleaning, oil the surface by running your thumb over the area.



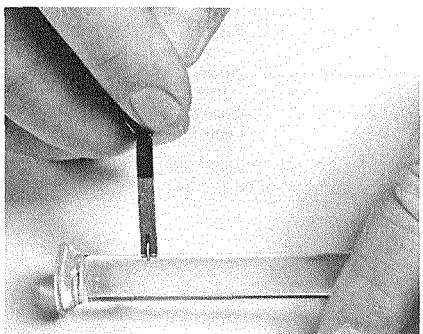
6 To make a good freehand cut, follow a line drawn on paper under the glass. Keep the cutter perpendicular.



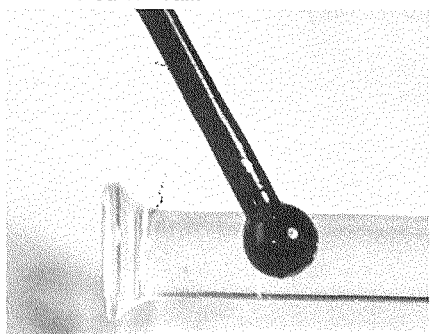
7 With practice, you can also make curved cuts without using a guide by following a line. Start cut at an edge.



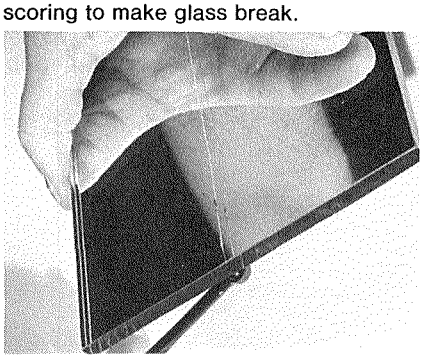
11 To cut glass rods properly, first score them with a cutter; then make the break in the desired location.



12 After first scoring them, glass rods are broken by tapping them sharply with the cutter ball.



13 Tap heavy mirrors or plate glass sharply with the cutter handle after scoring to make glass break.



■ IN TRUTH, glass isn't really cut; it's broken. The cutting tool creates a fissure, a line of stress. Glass will snap along this fissure when you apply a bending pressure. Different types of glass cutters are available (photos 1 and 2).

First, clean the glass. Use a razorblade scraper, commercial glass cleaner or No. 4/0 steel wool to remove dirt.

The cutting table should provide firm, even support for the glass (photo 3). Cut over a sheet of corrugated cardboard or several layers of newspaper.

You can easily cut glass to size for a storm window or a picture frame. Use the frame as a guide by cutting the glass over it (photo 4). Apply some electrician's tape to the bottom of the straightedge to cushion it.

To make freehand cuts, or to cut special shapes (photos 6 and 7), first draw the shape on paper. Slip it under the glass and then make the proper cut.

Before cutting, run your thumb along the cut line (photo 5). This body oil provides lubricant to prepare the surface.

Using a rule as a straightedge, hold the cutting tool perpendicular to the pane. Apply pressure and draw the tool across the glass. The cutter should make a small scratch.

The wheel should roll smoothly. If it skips and makes an irregular line, the cutter is dull and should be replaced.

If you make an irregular cut, don't retrace it. Doing so will damage the wheel. Make another cut on the backside of the glass along the same line.

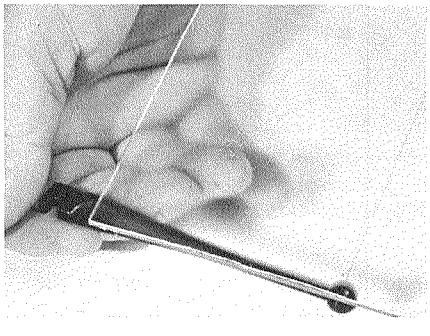
After making the cut, hold the glass in both hands between thumbs and index fingers, thumbs on top. If the glass is thick, tap it with the cutter ball to start the break (photo 8). Snap the glass apart with a bending motion (photo 9). The break will travel right along your cut line if you give it a positive snap.

Cutting a strip of glass less than ¼-in. wide is a more difficult job. To make the break after scoring, grip the strip with glazing pliers or standard pliers with jaws wrapped in tape (photo 10).

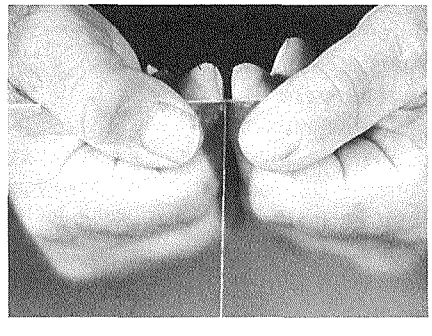
You can use an ordinary cutter to cut glass rod (photos 11 and 12), and to cut plate glass and heavy mirror. After scoring, use the ball on the cutter to tap under the score to start the break (photo 13). Then place a ¼-in. dowel or welding rod under the cut and push down on both sides of the glass (photo 14).

Sand rough edges with carbide sanding cloth (photo 15). Don't use a power sander as the glass may overheat and break.

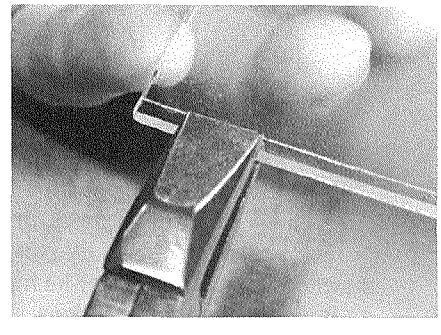
8 Tap the glass under the cut with the ball on the handle. This starts the break and makes snapping apart easier.



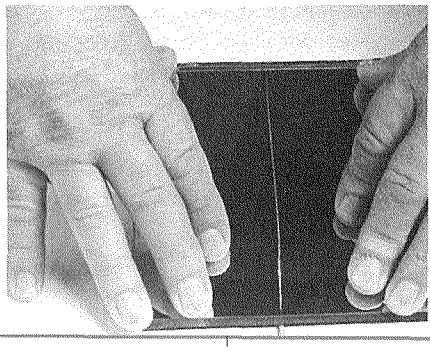
9 Hold the glass between thumbs and forefingers, close to the cut. For a clean cut, snap with bending motion.



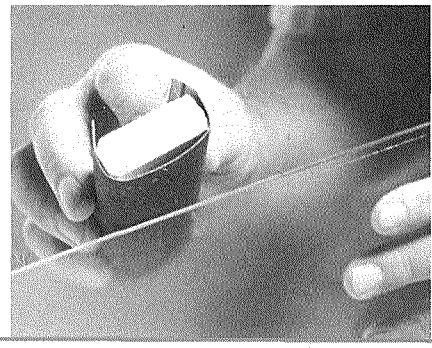
10 Use glazier's pliers to snap cuts near the edge. Or substitute ordinary pliers with masking tape on the jaws.



14 Then place a small rod under the cut to make the break easier when you push down on each side of the glass.



15 Smooth rough edges of the glass with a medium-fine carbide sanding cloth on a block.



COMMERCIALLY CUT GLASS

Some glass can't be cut with a household cutter. Tempered glass used in shower and oven doors must be cut *before* it's fired. Automotive safety glass, a sandwich of glass with a plastic core, must be cut on both sides. The plastic center is cut with a very thin blade.

GLASS-CUTTER MANUFACTURERS

The Fletcher-Terry Co., Spring Lane, Farmington, CT 06032
Red Devil Inc., 2400 Vauxhall Rd., Union, NJ 07083
Stanley Tools, Div. of The Stanley Works, New Britain, CT 06050

Super storage for shop hardware

ANOTHER GOOD TITLE for this article might have been "organize your organizers." Most of us sort brads, screws, washers and the like into any containers we can get our hands on.

The trouble with this is that all these nicely sorted items don't get stored in one central location. We all spend more time hunting for hardware than we would like to—and it's not uncommon to make a trip to the hardware store, only to turn up the required item afterwards.

C. E. "Doc" Banister came up with the solution shown here for his shop. He has organized his organizers in a single cabinet with a huge capacity. Unlike those commercial organizers, which provide plenty of compartments that are often too small for what you want to store, this cabinet will accommodate a variety of different sized containers.

Start by cutting the side, top and bottom pieces for the main cabinet box and the door boxes. Cut rabbets at the ends of parts A and D and on the back edge of parts A and B for the cabinet back (I). Next, cut the dadoes for the shelves. Note that the shelf widths given will provide ample space for large jelly and peanut butter jars in the center and baby food jars in the doors.

STORING ALL miscellaneous hardware in one place will save you time. Jars on shelves built into doors are held in place with wire retainers and turnbuttons.

Assemble the boxes with an eye to keeping them square. Use 4d finishing nails and glue. Add the back to the cabinet.

Make the cabinet door fronts 1 in. wider than the shelf box. This will allow them to meet at the center without interfering with the inner door

sides (D) when opening and closing.

Dowels and glue can be used to join the front frame members (G and F). Apply glue to rabbet and let in ⅛-in. A-C plywood (J), A side out. Clamp and allow to dry before adding retainers and turnbuttons.

Bend aluminum rod for the retainers, using a vise and bevel to obtain accurately spaced bends and the required angles.

See Detail 6 below for the measurements. Attach the retainers with wire clips and then install the turnbuttons.

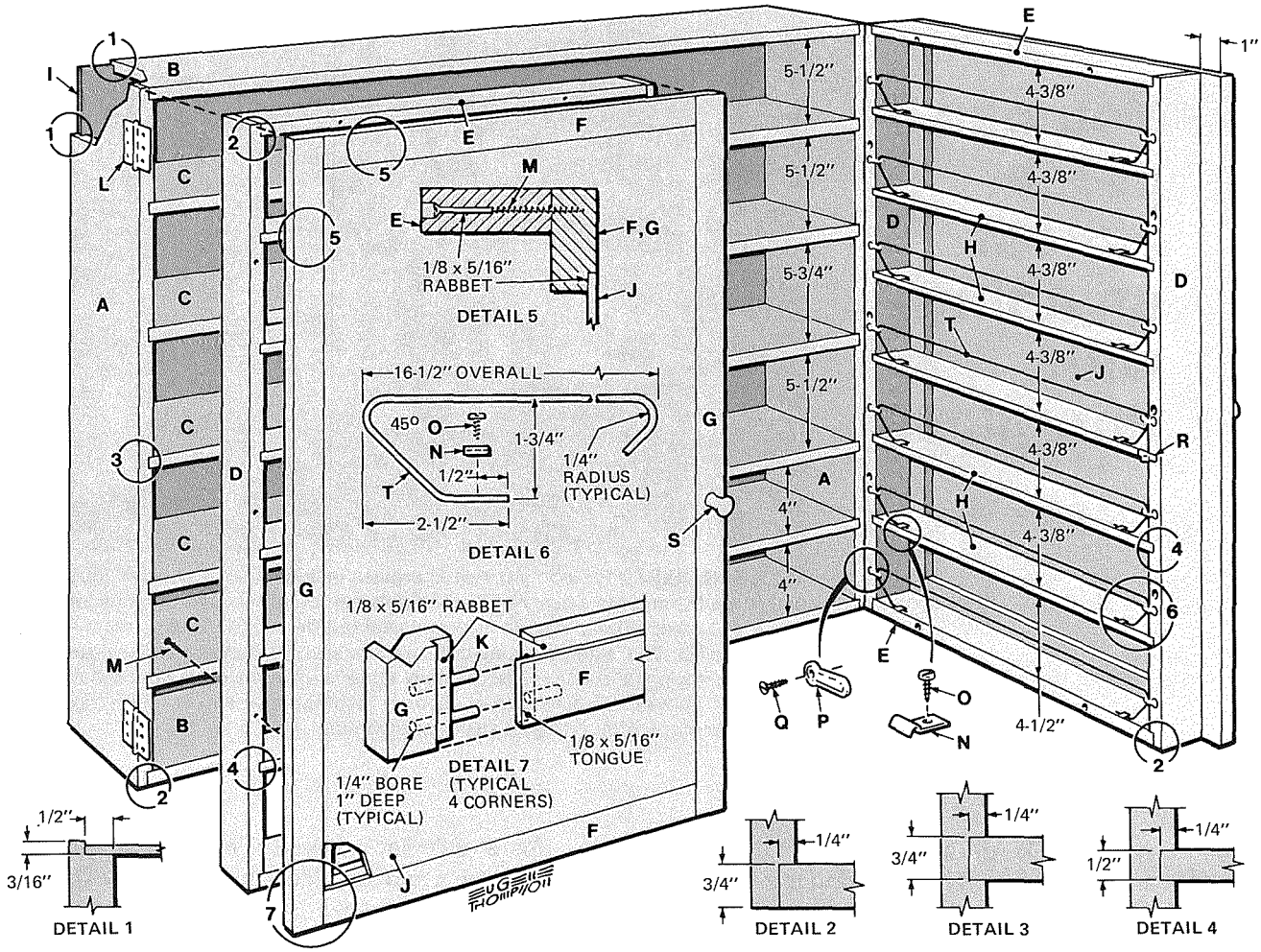
Assemble the shelf box and door fronts with screws installed through sides D and E and into F. Counterbore and plug to hide the screwheads.

The front panel, of course, can be nailed instead of screwed to the shelf box.

Hang the doors next. If you anticipate a heavy load, use three hinges per door instead of the two shown in the plans.

In either case, it's a good idea to use nuts and bolts to install the hinges to keep them from pulling out of the sides.

Although a clear finish was used on the prototype, latex primer and an enamel top coat can be substituted.



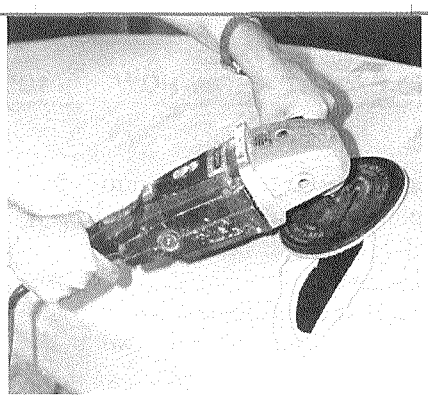
MATERIALS LIST—STORAGE CABINET

Key	No.	Size and description (use)
A	2	¾ × 6¹¹⁄₁₆ × 35¼" pine (cabinet sides)
B	2	¾ × 6¹¹⁄₁₆ × 38" pine (cabinet top and bottom)
C	5	¾ × 6½ × 38" pine (cabinet shelves)
D	4	¾ × 2¼ × 35¼" pine (door top and bottom)
E	4	¾ × 2¼ × 17½" pine (door top and bottom)
F	4	¾ × 1¾ × 16⅝" pine (door frame, top and bottom)
G	4	¾ × 1¾ × 35¼" pine (door-frame sides)
H	12	½ × 2¼ × 17½" pine (door shelves)
I	1	⅛ × 34¾ × 38½" tempered hardboard (cabinet back)
J	2	⅛ × 16⅝ × 32⅜" tempered hardboard or plywood (door front)
K	16	¼"-dia. × 2" dowels (to reinforce joints)
L	4	3" loose pin door hinge
M	20	No. 10 × 2½" fh wood screw
N	28	electric wire clip*
O	28	No. 6 × ⅜" sheet-metal screw
P	28	turnbutton**
Q	28	No. 4 × ½" fh wood screw
R	2	roller catch
S	2	knob
T	14	⅛"-dia. × 24" aluminum rod

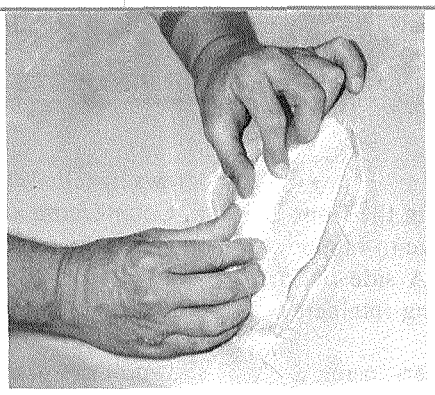
Misc.: Nails, glue, baby food or jelly jars to suit.

*The electric clips are carried by most electric supply outlets.

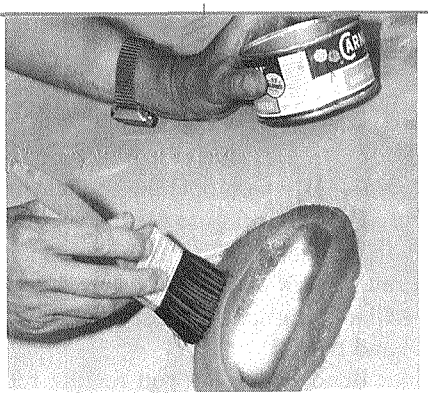
**The turnbuttons are available from Craftsman Wood Service, 2727 South Mary St., Chicago, Ill., 60608.



1 Repairing a hole or dent in a boat or car is relatively easy with fiberglass-reinforced plastic. First, sand the hole or dent until it is bowl-shaped. The repair shown here is from the outside because the back is inaccessible.



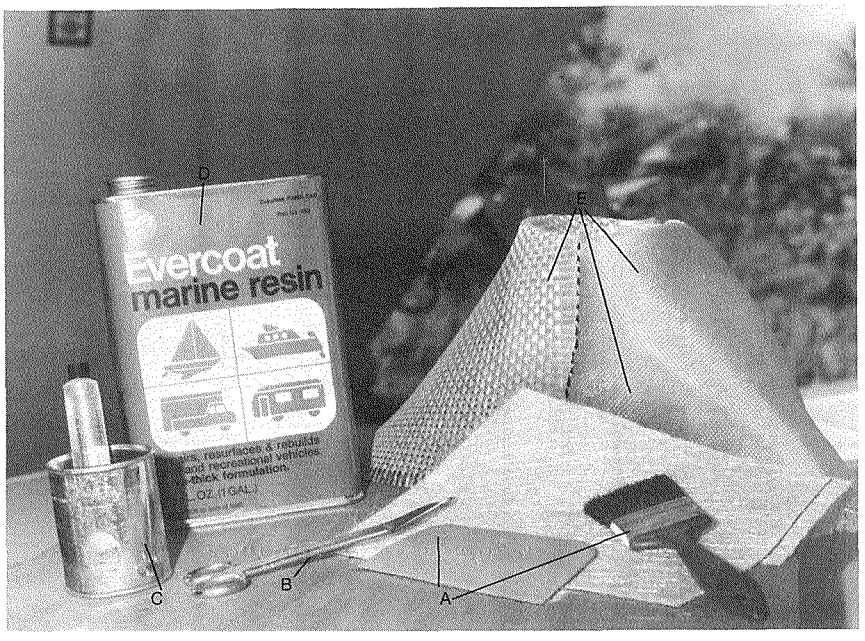
2 When the hole is sanded, and there are no rough edges, shape a piece of mat to fit the depression. Brush on a coat of catalyzed resin and apply patch. If the back is accessible, cover the hole with glass from the back side.



3 Starting at edge, daub (do not stroke) brush filled with catalyzed resin firmly into glass. It must be thoroughly saturated. Work slowly toward center, making certain that the area within the hole is depressed and flush with the back.

You can patch almost anything with fiberglass

By ALLAN L. PEARCE



TOOLS REQUIRED for working with fiberglass include an inexpensive brush or squeegee (A) and old scissors (B). Materials can be purchased at many lumberyards and paint stores. They include catalyst (hardener) (C), quality resin (D) and fiberglass (E). The different types of fiberglass are: *Mat* (shown under brush), used for filling; *roving*, a loose weave of heavy strands used for extra strength and thickness (left, above); and *fine* weave, used for smooth finish and strength (right, above). Acetone, not shown, is used for cleanup.

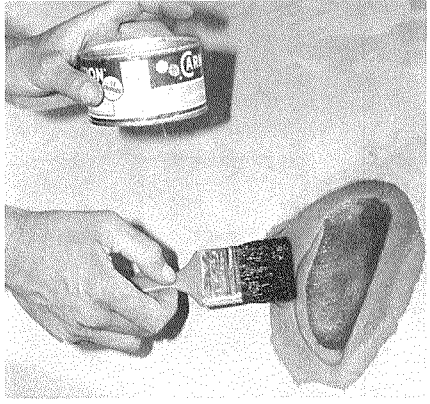
■ FIBERGLASS and resin should be a part of every workshop. They are relatively easy to work with, form lasting repairs on nearly anything found around the home, and have many other handy uses.

Fiberglass is generally available in three forms: a tight weave of lightweight cloth; a mat, consisting of closely packed fibers; and roving, a loose-weave of heavy cloth. Depending on type and quantity purchased, fiberglass costs $2 to $5 per yard. The material can be easily cut with scissors or a sharp knife to any desired size. When united with resin, it becomes as strong as steel.

There are several types of resin, each designed for a different purpose. The type we are interested in here is called laminating resin. Quality resins cost about $20 per gallon. As a rule, however, the least expensive you can find is adequate for repairs around the home. If there is a doubt, read the label.

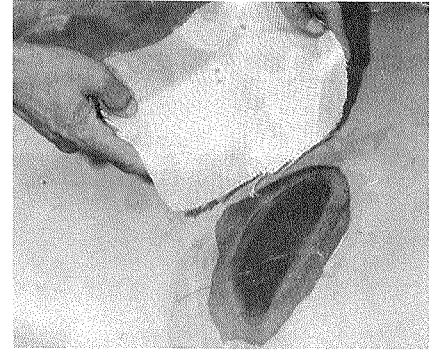
When a hardener (catalyst) is added to resin, it reacts chemically to form a solid. Alone, this solid has little strength, although it is ideal for securing bolts in concrete. While still wet, the resin bleeds into the concrete, creating a deep bond. At the same time, it locks the fastener into its hole.

Safety goggles as well as a dust mask when sanding fiberglass are musts. Work in a well-

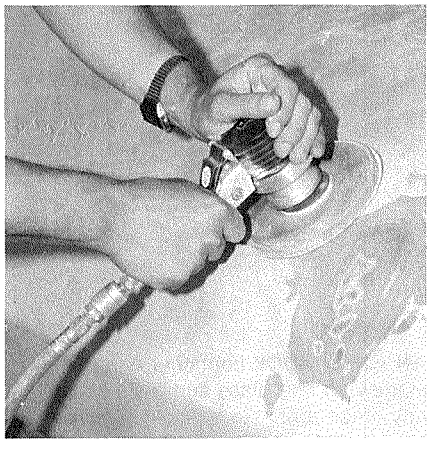


4 This is the way the repair project should look after the first piece of mat has been thoroughly wetted out.

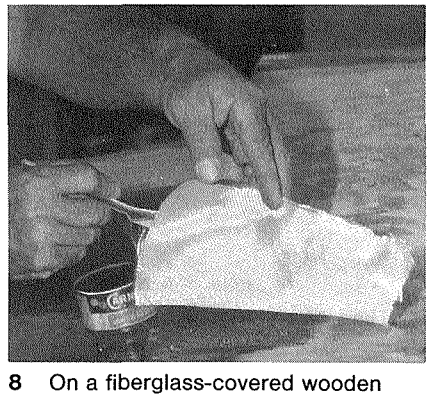
5 Cut several pieces of mat in different sizes to fill hole. After initial layer has jelled, but is still tacky to touch, start filling the depression again. Always daub; to not attempt to brush. Daub firmly to remove air bubbles.



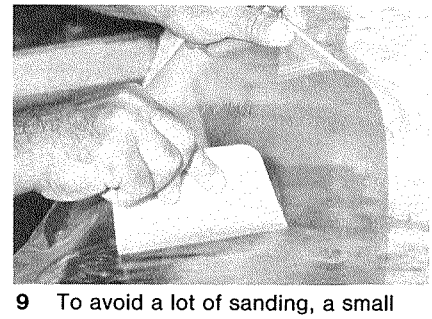
6 When the depression has filled to where it is nearly even with the surface, lay on a piece of fiberglass cloth. The cloth must extend well beyond filled hole to edges of sanded area.



7 After the patch has completely dried, sand smooth, and paint. Use wet or dry sandpaper, working from coarse grit to extremely fine, depending on how smooth a finish you desire.

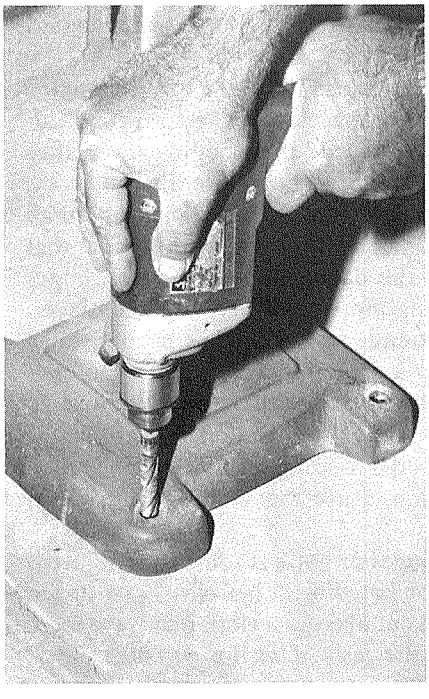


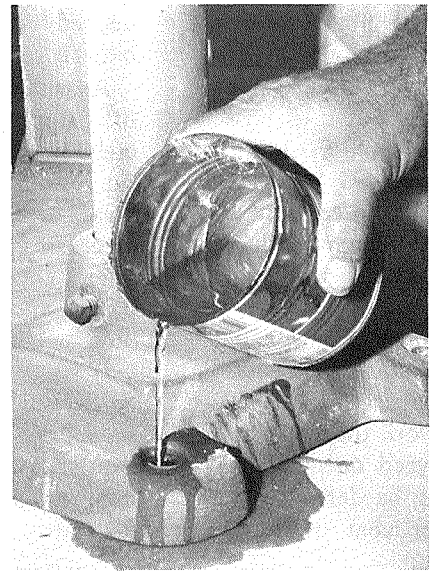
8 On a fiberglass-covered wooden boat, where the exterior cover or shell is sometimes broken, the damaged area can usually be repaired with a single layer of glass. Sand away the damaged glass, lay on a new piece, and daub with resin. Be sure that all air bubbles have been removed.

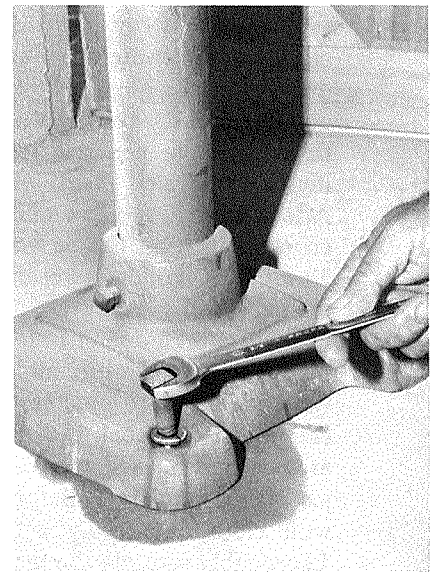


9 To avoid a lot of sanding, a small area can be covered with clear polyethylene plastic after layering has been completed. Pour on an excessive amount of resin. Hold the piece of plastic as shown and slowly squeegee it over the repaired area. Excess resin should be worked out from under the plastic, and the plastic must be laid out smoothly. Wrinkles in plastic will be transferred to resin.

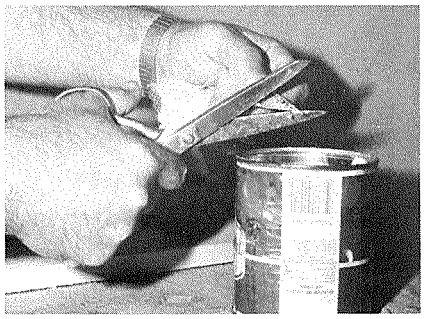
OTHER WAYS TO USE FIBERGLASS



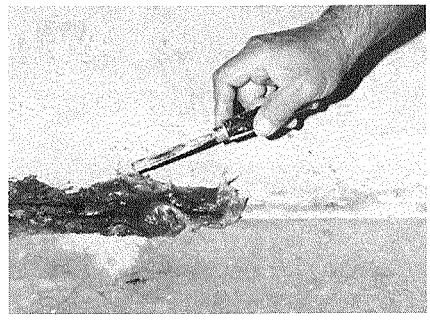




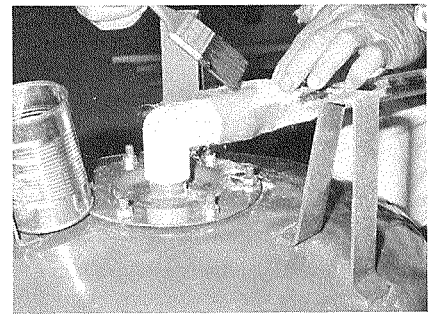
ANY HOUSEHOLD or workshop tool may be more securely bound to a concrete floor by first filling the hole with a polyester resin. The lagbolts must then be screwed in place before the polyester resin hardens. Screws or bolts that are attached in this manner cannot be removed except by cutting off their heads.



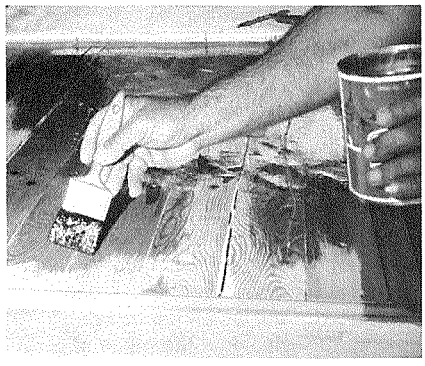
FIBERGLASS cloth, when cut into tiny pieces, can be mixed with catalyzed resin to create a putty-like material.



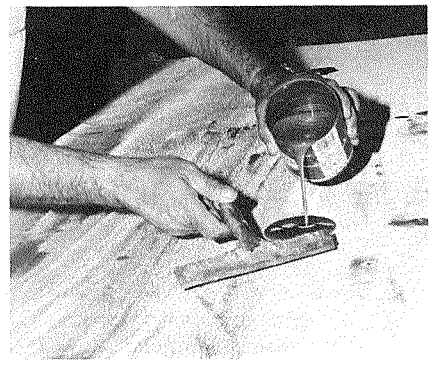
THE PUTTY can be used to permanently repair cracks in concrete or even holes in the roof.



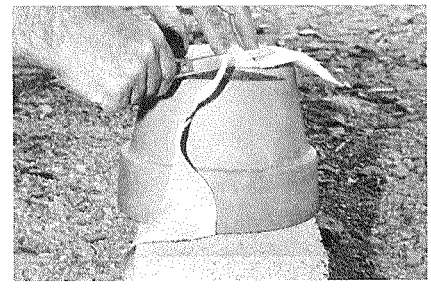
RESIN and fiberglass can be used to repair a crack in the plastic, where a pipe run changes from metal to plastic.



TO WEATHERPROOF large items, such as the picnic table shown, paint surface with catalyzed resin.



BEFORE RESIN hardens, lay glass in place and saturate. Divide work into small areas.



AN ACID-PROOF container can be made with fiberglass and resin using any other container as mold. Several layers of glass should be laid for a permanent container. Use fiberglass mat for thicker walls.

ventilated area (preferably outside) with no open flames. Gloves are also recommended when operation permits—or else coat hands with petroleum jelly.

Repairs that can be made with fiberglass include sealing (waterproofing), patching holes or dents, and plugging of voids. You can seal just about anything you don't want water to pass through—from concrete to the roof. First, the item to be sealed *should be thoroughly cleaned.* After cleaning, mix enough resin and catalyst to cover an area that can be worked in no more than 20 minutes. Follow label directions carefully in mixing.

Resin will harden in 15 to 30 minutes, depending on the temperature and the amount of catalyst added. Follow time and temperature specifications on the label. Do not work too large an area at one time. Apply catalyzed resin to object being repaired. Before it hardens, cover with cloth and apply another coat of resin. Thoroughly saturate the material.

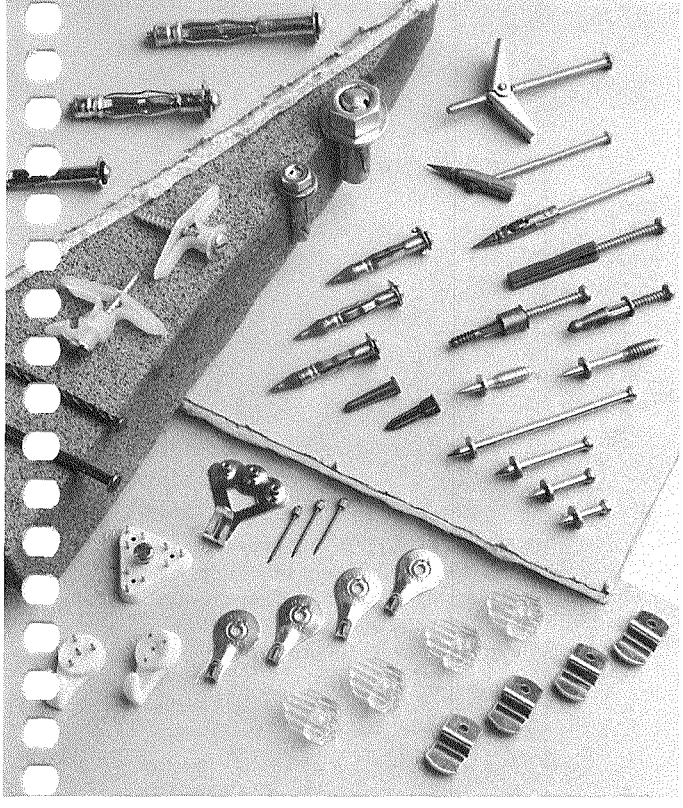
Smooth the cloth, making sure it's free of bubbles and wrinkles. An inexpensive paintbrush works well, but for sealing a large area, a squeegee works must faster. Clean up with acetone.

Patching is accomplished much the same way as sealing. Use the technique on such items as a water pipe, a muffler (heat-resistant resin is needed for this), rain gutters, even a concrete bird bath in your yard.

As with sealing, clean the surface to be patched first. Apply two or three coats of resin with hardener, making each additional application after the resin had hardened, but while it's still tacky. Next, depending on size of the hole, cut small pieces of fiberglass cloth. Begin with a piece that barely covers the damaged area. Lay on larger pieces, applying more resin between each layer, until patch extends several inches beyond hole.

If you want a smooth surface, get a sanding-type resin. But, remember, this type resin must be sanded between each application. I keep both a regular resin and a sanding resin on hand. On the final application, I use the sanding resin when necessary.

Plugging gouges or holes is somewhat different than sealing or patching. First clean area to be plugged. Then cut fiberglass cloth into tiny pieces and mix into the resin. Use this just like putty.



SOME ARE FAMILIAR old standbys, but others look strange. Among many fasteners available are clever new types to make hanging jobs faster and easier.

How to hang anything on any wall

Some fasteners are better than others for certain jobs. Here are the latest types with tips on how to pick the right ones for your needs

By JOHN H. INGERSOLL

SEARCHING THROUGH JUNK at an abandoned housing site, a Baltimore youngster found an old manhole cover. The happy new owner drove some nails in a bedroom wall and proudly wired up his treasure for everyone to see.

What everyone saw was a jagged hole in the wall where the cover had torn loose and crashed to the floor. Cast-iron manhole covers weigh over 100 lbs., and the wall was of thin plasterboard. An impossible hanging job? Not at all.

Most of us don't have to hang manhole covers on our walls, but we do have to put up a lot of other things—often objects just as heavy, and often on walls where no studs are handy and the surface won't take ordinary nails or screws. Fortunately, there is a wide variety of fasteners made especially to solve such problems.

toggles for tough jobs

Toggle bolts are designed for hollow walls, such as plaster, plasterboard and paneling. The toggle folds or pivots so you can insert it in a hole, then it flips open behind the wall to form a clamp as the bolt is drawn up tight. Because toggles spread the load over a broad area, they can support heavy objects like cabinets, bulletin boards and shelves on brackets. They range in length from 2 to 6 in.

Where a bolt head may tend to pull through what you're hanging, such as soft materials like wood, slip a washer under the head to give a firm grip. (This also applies to other fasteners shown here, where a screw or bolt is used to support the load.) For a neater appearance where bolt heads will show, you can use cup washers instead of ordinary flat ones. Slicker still are Snap Caps made by Bostik. These are plastic washers with decorative snap-on caps that fit over exposed screw or bolt heads to conceal them from view and also protect them from weather when used outdoors. Snap Caps come in white, brown and black and in several sizes.

While toggle bolts are inexpensive and strong, they do have some drawbacks. To provide clearance for the toggle, you have to drill a hole about three times the size of the bolt (½-in. hole for 3/16-in. bolt). This hole will sometimes show if the object you're hanging is narrow. Also, you have to attach the bolt to the object before inserting the toggle in the wall. Once in place, the bolt can't be removed without the toggle falling off inside the wall. This makes it hard to hang heavy things that require a number of bolts—lining up all the toggles so they slip into their holes at exactly the same time. And if you remove the bolts later, you will lose the toggles.

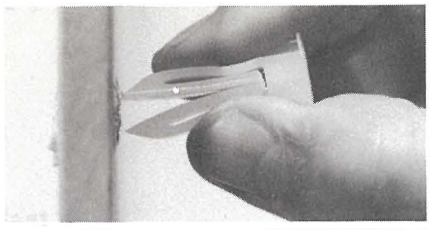
new locking toggles

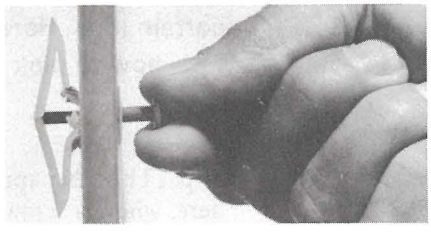
Two new toggle-type fasteners are aimed at eliminating these problems. One, called the Kap-Toggle, requires a hole only slightly larger than the bolt and has plastic arms and a collar that lock the toggle in the wall before the bolt is inserted. You can mount the toggle first, then attach your fixture later. The collar hides the hole, and the bolt can be removed without any risk of the toggle dropping off.

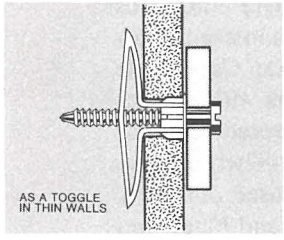
Kap Toggles are 2 in. long and come in ⅛-, 3/16- and ¼-in. bolt diameters. They're made by Universal Fastenings Corp., Box B, Farmingdale, NY 11735.

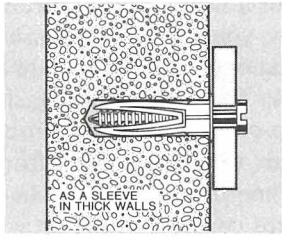
The other newcomer is the Toggler. Its toggle legs are plastic instead of metal. You squeeze

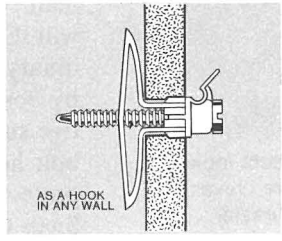
IT'S A HOOK, IT'S A TOGGLE, IT'S A MASONRY ANCHOR





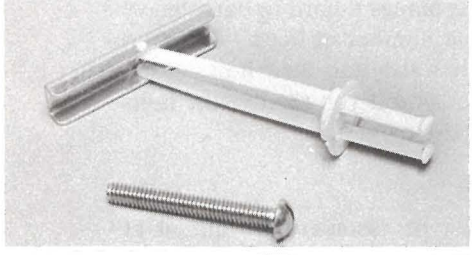


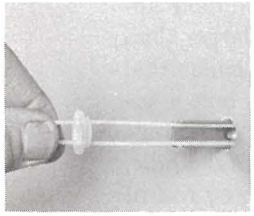


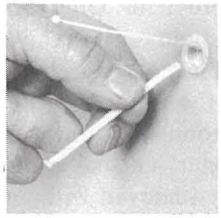


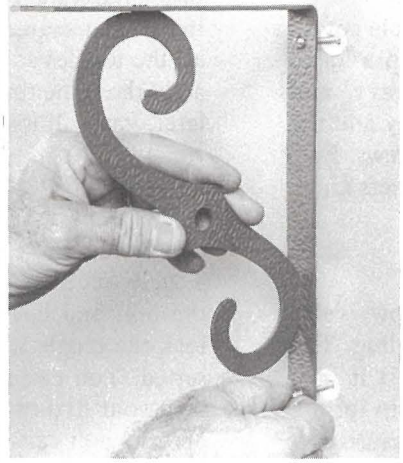
THIS VERSATILE new fastener will work in any wall—thick, thin, hollow or solid. Called the Toggler, it's made of plastic and comes in two styles. One has a molded hook on the head for direct hanging. The other, without hook, serves as a general-purpose anchor. In hollow walls, the fastener works like a toggle bolt. You squeeze the legs together, insert them through a hole, and they spring open behind the wall to grip the back side (photos, upper right). In thick walls the legs press outward like a sleeve as a screw is turned in, wedging the anchor in place. Togglers are made by Mechanical Plastics Corp., Pleasantville, NY 10570.

LOCKING TOGGLE GIVES A PERMANENT GRIP



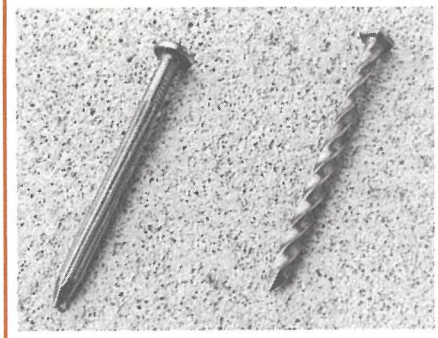




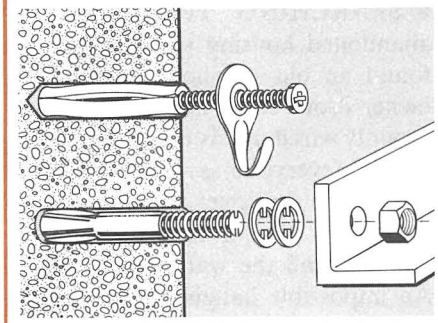


THE TOGGLE doesn't fall off this fastener and get lost inside the wall if you remove the bolt. Called KapToggle, the anchor has plastic arms and a collar that lock in the wall before the bolt is inserted. You slip it through a hole (lower left), then slide the collar up to the wall and break the arms off flush (center). The fixture (right) can be mounted after all anchors are installed, and the bolts can be removed without losing the toggles. The fasteners can be used in hollow walls of any thickness, and the collar hides the hole from view. They're from Universal Fastenings Corp., Box B, Farmingdale, NY 11735.

SPECIAL NAILS AND ANCHORS



HARDENED-STEEL masonry nails have either straight or spiral ribs for increased holding power. They can be driven directly into concrete and cement blocks with an ordinary hammer.

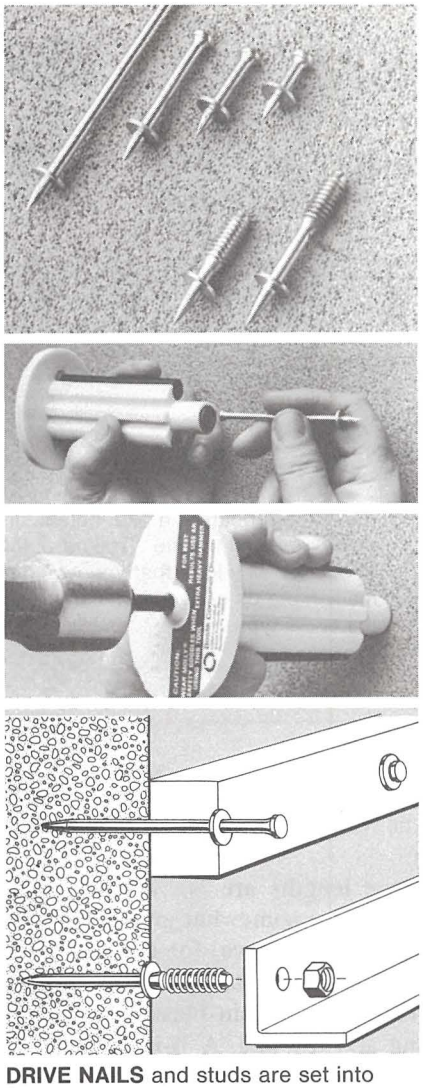


EXPANSION SHIELDS come in plastic, soft lead and steel. The Wej-It is shown at right in photo and in lower drawing. Its bolt and shield are combined in one easy-to-install unit. You merely tap it into a hole and turn it up tight with a wrench to expand sides and lock it into the wall.

HANDY HOOKS AND CLIPS

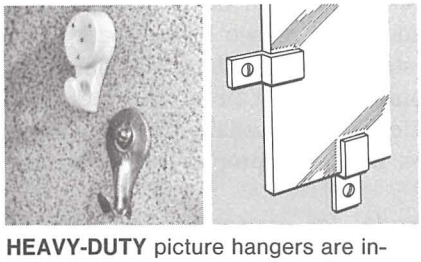
NEW METAL wall hooks (upper left) work with almost any anchor, have knock-out rings to enlarge hole for big screws or bolts. Plastic hooks (bottom center) have drive pins that can be hammered directly into concrete (right).

FOR MASONRY JOBS



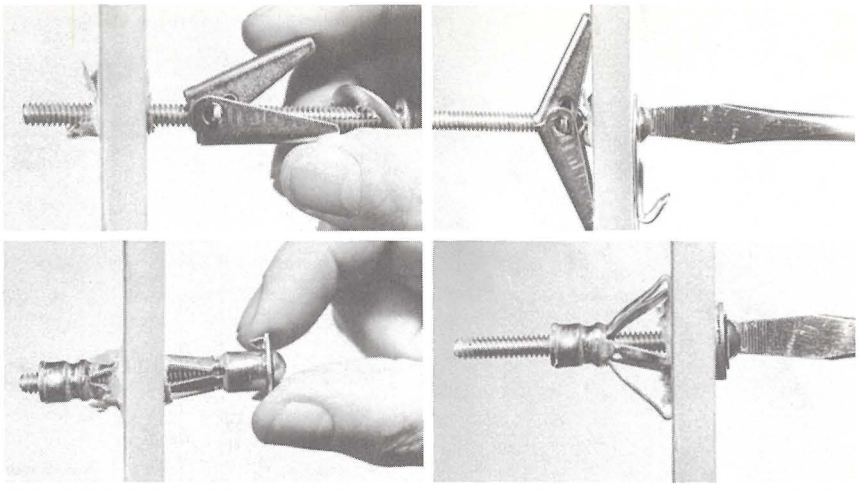
DRIVE NAILS and studs are set into concrete with special tool. Fastener is inserted in tool, then plunger is struck with a hammer. Nails hold studs, furring strips (upper drawing). Threaded stud type takes standard ¼-in. nuts for attaching metal items to concrete.

FOR MANY USES

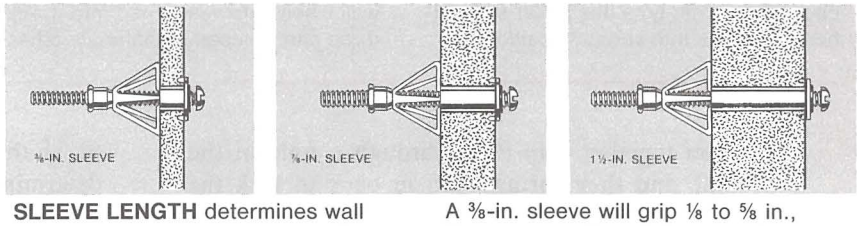


HEAVY-DUTY picture hangers are installed with three pins to spread the load. Mirror clips, in either metal or plastic, support flat objects you can't drill. They are particularly good for glass photo mounts and mirrors

HOLLOW-WALL FASTENERS FOR HEAVY LOADS

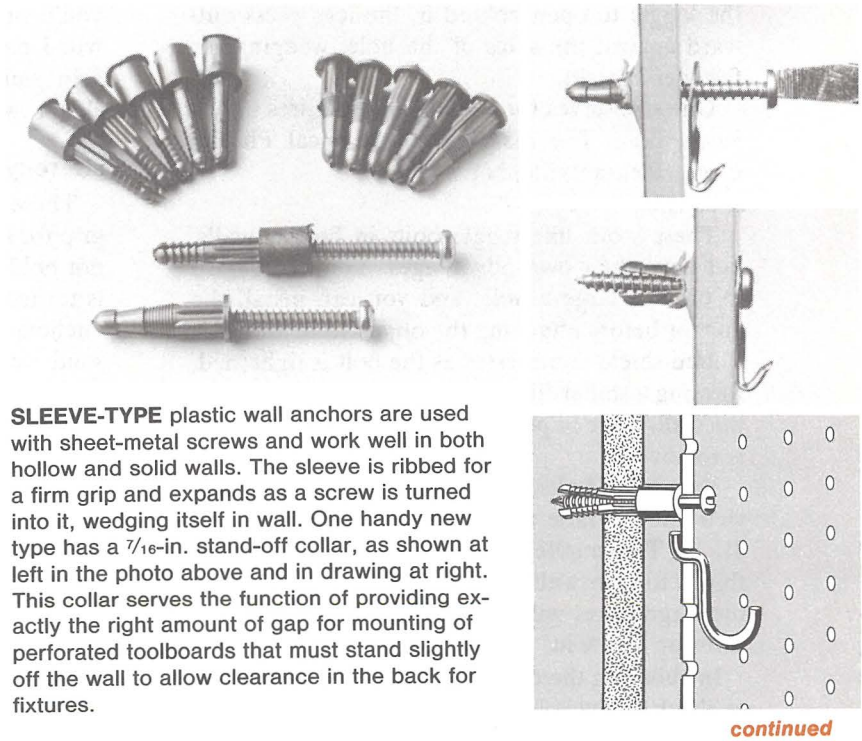


TOGGLE BOLT (top) has spring-loaded legs that compress for insertion in wall, then spring open behind it to lock the bolt in place. Because toggle threads on bolt, fixture must be attached before toggle is inserted. Expansion bolt (bottom) has slotted shield that expands behind wall as bolt is tightened, clamping it in place. The bolt can then be removed without the anchor falling out.



SLEEVE LENGTH determines wall thickness that expansion bolt will grip, and is the critical dimension to look for. A ⅜-in. sleeve will grip ⅛ to ⅝ in., ⅞-in. sleeve, ⅝ to 1¼ in., 1½-in. sleeve, 1¼ to 1¾ in.

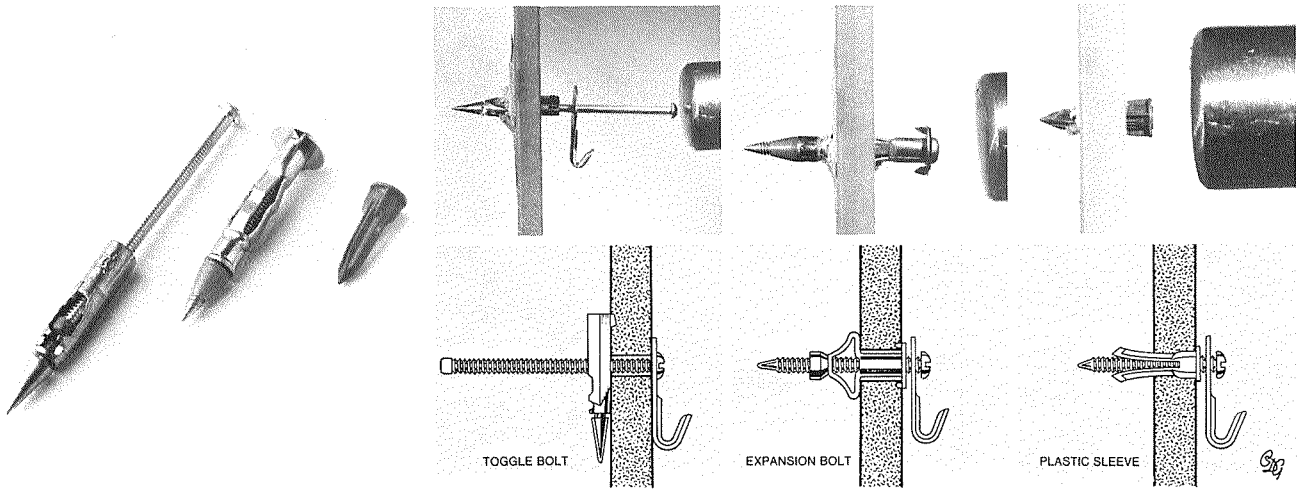
WALL ANCHORS AND TOOLBOARD HOLDERS



SLEEVE-TYPE plastic wall anchors are used with sheet-metal screws and work well in both hollow and solid walls. The sleeve is ribbed for a firm grip and expands as a screw is turned into it, wedging itself in wall. One handy new type has a 7/16-in. stand-off collar, as shown at left in the photo above and in drawing at right. This collar serves the function of providing exactly the right amount of gap for mounting of perforated toolboards that must stand slightly off the wall to allow clearance in the back for fixtures.

continued

SELF-DRILLING WALL ANCHORS YOU DRIVE WITH A HAMMER



NEW NAILABLE wall anchors above need no pilot hole when used in plasterboard—you just drive them in with a hammer. They are (left to right): toggle bolt, expansion bolt, sleeve-type anchor. The toggle type has bullet-shaped head that flips into vertical position behind wall, locking fastener in place. Expansion type has pointed tip with slotted shield that expands behind wall when its bolt is tightened. Sleeve type is of hard plastic and wedges tightly in wall when screw is turned into it. All three can be used in materials other than plasterboard if a pilot hole is first drilled in usual manner. They are able to support any load that you would normally hang on conventional anchors of the same type.

them together, slip them through a hole in the wall, and they spring open in back to lock the toggle in place. A sheet-metal screw draws the toggle up tight, but it isn't necessary for you to insert it until you're ready to attach the fixture.

Togglers work not only in hollow walls, but in solid ones, as well. Where a wall is too thick for the toggle to open behind it, the legs press outward against the sides of the hole, wedging the fastener in tight.

One size serves for all uses and requires only a 5/16-in. hole. The maker is Mechanical Plastics Corp., Pleasantville, NY 10570.

expansion bolts

These work like toggle bolts in hollow walls, but have their own advantages. You don't need to bore as large a hole, and you can install the anchor before attaching the object to be hung. A slotted shield compresses as the bolt is tightened, forming a spider-like clamp that grips the back of the wall. Once in place, it won't fall out if the bolt is removed.

Expansion bolts, often called Mollies after one well-known trade name, come in lengths of 1 to 3½ in. The smaller sizes are good for fastening things to thin walls and hollow-core doors, and the larger ones will support heavy loads in surfaces up to 1¾ in. thick.

In choosing the correct size, the key dimension to check is sleeve length. This is the distance between the bolt head and the expansion shield and determines the wall thickness that a particular size will grip.

Typical sleeve lengths are ⅜, ⅞ and 1½ in. Each has a grip range somewhat greater than its actual length. A ⅜-in. sleeve, for example, will work in walls from ⅛ to ⅝ in. thick and is the one you'd pick for general use in plasterboard, plywood paneling and the like. A ⅞-in. sleeve will grip walls from ⅝- to 1¼-in. thick; a 1½-in. sleeve, walls from 1¼-to 1¾-in. thick.

sleeve-type wall anchors

These are plastic or fiber sleeves that provide a grip for screws in walls where screws alone would not hold securely. The sleeve expands as a screw is turned into it, wedging itself in the wall. Such anchors work equally well in both hollow and solid walls and come in two basic types. Those made for plaster, plasterboard and paneling have a tapered, conical shape. You tap the sleeve into a slightly undersize hole, usually specified on the package, then insert the proper-size screw, also specified.

Sleeves made for masonry are typically straight-sided and come in lead as well as plastic. Lead anchors in the larger sizes are called expansion shields and take heavy lagscrews. These are the type to use for fastening heavy fixtures, metal railings and wood timbers to concrete.

self-drilling anchors

Among the latest fasteners are three nifty new types that require no predrilling when used in plasterboard—you just drive them in with a hammer like a nail. They have sharp-pointed, bullet-shaped tips that make their own holes and come in the same styles as conventional anchors—sleeve, toggle and expansion.

The sleeve type is of hard plastic and is used with screws; the toggle and expansion types are metal and have bolts. The expansion style, in its smaller sizes, can even be driven into hollow-core doors without a pilot hole. Once hammered in, all three function in the same way as their conventional counterparts. They can also be used in materials other than plasterboard if a starter hole is drilled normally.

Self-drilling expansion bolts are made under the Molly name by Bostik Consumer Div., USM Corp., 4408 Pottsville Pike, Reading, PA 19605. The sleeve and toggle types are made by Homecraft Div., Gries, 125 Beechwood Ave., New Rochelle, NY 10802.

masonry anchors

In addition to the lead and plastic sleeves already mentioned, you have several other masonry anchors to choose from. One slick new type is called Wej-It. It works like a lead expansion shield except that the bolt and shield are one unit. You merely tap it into a hole and tighten the bolt with a wrench. The sides expand as the bolt is turned, providing tremendous gripping force. Wej-Its come in several sizes and support up to 2000 lbs. in cement block and more than 5000 lbs. in solid concrete. They're made by Wej-It Corp., 500 Alter St., Broomfield, CO 80020.

If you don't want to drill into masonry, you have other choices. Hardened-steel masonry nails can be driven directly into concrete and cement block and offer a fast way of putting up studs, furring strips, long runs of conduit—anything requiring so many fasteners that drilling holes for screw anchors would be tedious. Be sure to wear safety goggles.

drive pins and studs

These are special masonry nails that are driven with the aid of an accessory drive tool. The tool works something like a miniature pile driver. It holds a pin in a chamber as a plunger is struck with a heavy hammer. Because it guides the pin straight and concentrates force directly on the head, it makes nailing in concrete quick, easy and accurate.

Drive pins look like ordinary nails except that they have a collar lightly welded near the point. As a pin is driven, the collar breaks away and rides up the shank to form a washer under the head. The pins come in lengths from ¾ to 3 in. and are ideal for fastening studs and furring strips to masonry.

Drive studs are installed in the same way, but have threaded shanks that take ¼-20 nuts. These are handy for metal fixtures, especially those that must be removed from time to time. The pins, studs and drive tool are all made by Bostik.

handy hooks and clips

Two general-purpose hangers worth knowing about are metal wall hooks and plastic masonry hooks. The metal type has a flat hanging tab with a hole in it and can be used with any wall fastener that takes a screw or bolt. A knock-out ring can be removed to enlarge the hole for big anchors. The plastic type is new and has small, headless drive pins that can be hammered directly into masonry.

Mirror clips, available in chrome and plastic, are handy for holding thin, flat objects that you can't or don't want to make holes in. In addition to mirrors, they'll grip unframed pictures, map boards, message centers, wall plaques and the like.

how much will they hold?

Except for picture hooks and some masonry anchors, most makers do not rate their fasteners according to the weight they'll carry. This is simply because they have no way of knowing what material a particular fastener will be mounted in, or how many will be used to support a given load. Within reason, the heavier the anchor and the more you use, the more you can hang—at least up to the limit of what the wall itself will hold.

As a working rule, you can figure that hollow walls will support up to 50 lbs. per anchor and solid walls up to 100. But this doesn't necessarily mean that 10 hooks in a thin wall will hold up a 500-lb. piece of marble sculpture—the hooks might, but the wall probably won't. You have to use judgment here.

All fasteners are at their strongest when the load is "in shear" or at right angles to the mounting. Some are better than others, however, when they're placed under tension. Sleeve-type anchors, for instance, are not recommended for overhead use, such as for suspending heavy objects from ceilings, where the pull is straight out. In this case, screw into ceiling joists or use toggle or expansion bolts that grip the back side of the ceiling. For objects like ceiling-hung planters, there are special toggles with eyebolts that you can easily hook into.

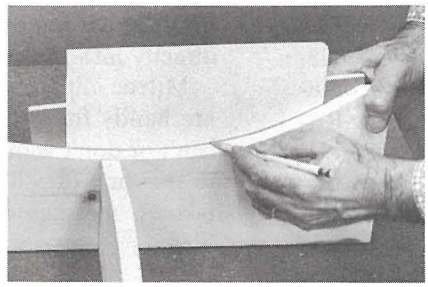
Woodworking secrets from master craftsmen

AUXILIARY ROUTER BASE MOLDS CURVED EDGES

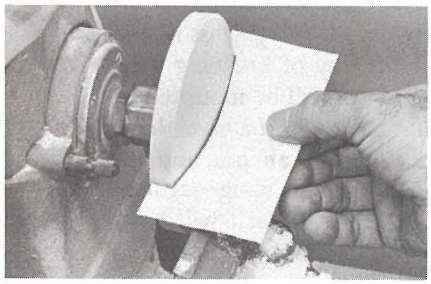
Shaping the edges of a free-form curved shelf unit before assembling the sides makes it nearly impossible to accurately mate the curved, shaped edges where shelf and sides meet. Shaping all the edges afterward makes the task simpler.

To make a router base for this task, cut a softwood disc to the diameter of your router base. Mount the disc on a lathe faceplate and turn it to a convex shape having a radius no greater than the smallest radius in the curved edges of your project. Hold router perpendicular to tangent of each inside and outside curve.—*Emery J. Loisell*

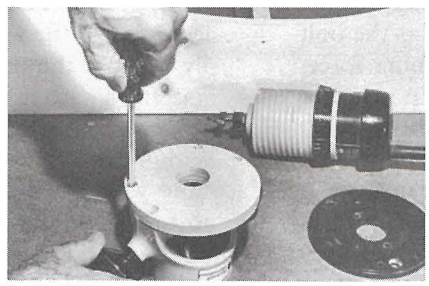
CONVEX ROUTER base lets you shape a curved edge, is guided by a piloted bit.



TO MAKE base template, trace smallest radius curve onto stiff cardboard.



TURN A SOFTWOOD disc to shape, using the template to check progress.

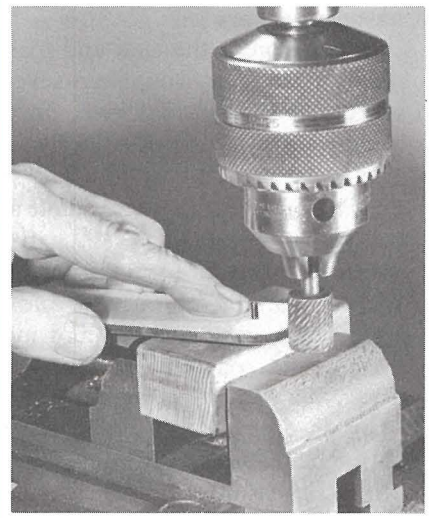


TO USE, remove the original base and screw the convex base in its place.

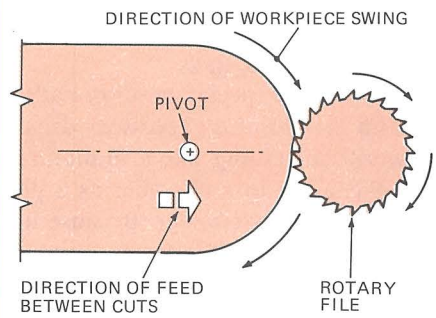
ROUND ENDS NEATLY

It is often desirable to produce rounded ends on strips of metal, hardboard, or other material, with each curve's radius extending from a hole for a screw or rivet. This method makes it easy.

Drill the required holes in work and rough-cut rounded ends on a saw. Choose a nail with the same diameter as the hole and drive it into a wooden block. Then clamp the block in a drillpress milling-table vise and cut off the pivot nailhead. Be sure the centerline of the work is aligned with center of rotary file.—*Walter E. Burton*



MILLING TABLE allows work to be fed into the rotary file at 1/16 in. per pass.



SWING STRIP so its end moves against the rotation of the file, as shown here.

RUB TREATED rope against grooves.

MAKE RUSTY AUGER BITS SHINE

You can clean a rusty auger bit until it shines like new. Squirt a few drops of machine oil on a piece of manila or sisal rope. Then roll it in some fine sand or powered pumice until the surface is coated. Wind the rope once around the bit and pull the ends back and forth to remove the rust, working your way from the shank to the tip. Select a rope size to match the groove of the bit being cleaned.—*Ralph S. Wilkes*

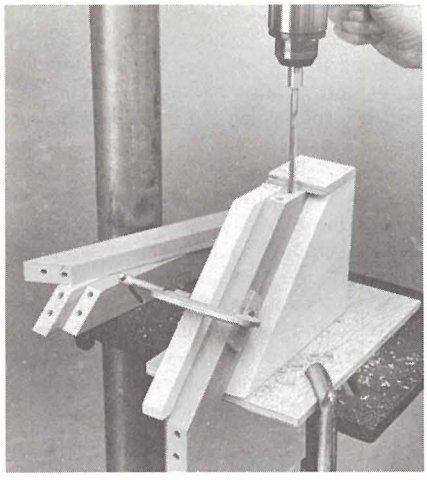
DRILL ACCURATE HOLES FOR DOWELED MITER JOINTS

This jig, designed for use on a drill press, will enable you to accurately drill dowel holes perpendicular to the face of a 45° miter. Use a single piece of ¾-in. stock for the side stop and a doubled-up piece for the back stop. Cut the top and base to the dimensions shown.

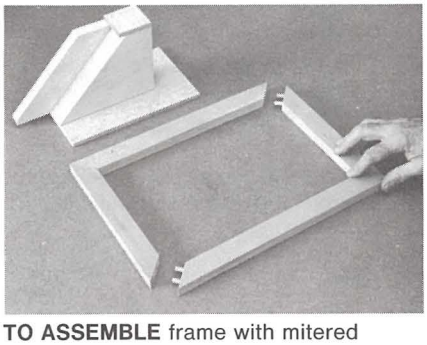
To use the jig, set the drill depth stop as required and clamp the work to the jig.

Mark a centerline on the mitered edge face and position the jig so the drill point is on dead center. Then clamp the jig to the drill-press table. If you are using two dowels for each joint, drill the first holes in all the pieces before shifting the jig into position for the second set of holes.

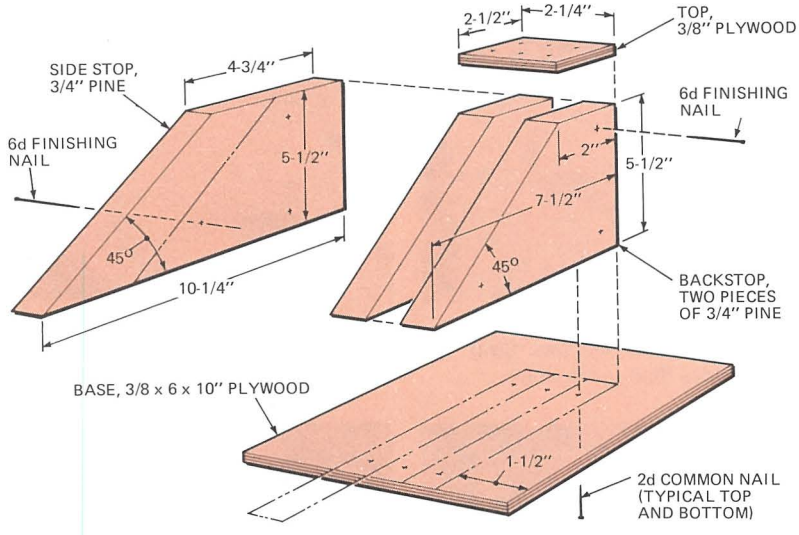
First assemble two diagonal corners of the frame, then join the others in unison.—*Ralph S. Wilkes*



ALIGN BIT with point to be drilled and then clamp jig to the table.



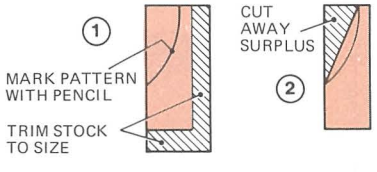
TO ASSEMBLE frame with mitered joints, first join the two diagonal corners.

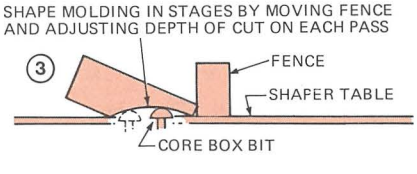


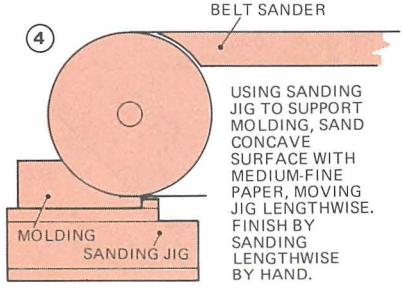
MAKING YOUR OWN LARGE-SIZE MOLDING

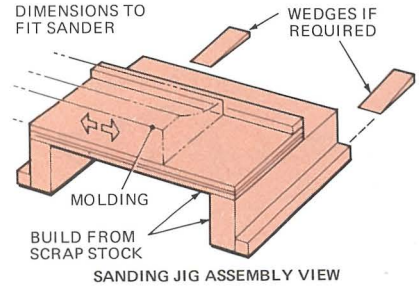
You can make a large-size piece of concave molding using a saw, a small shaper and a belt sander. First make a pattern of the molding cross section. Cut a piece of stock to the right overall dimensions and trace the pattern on one end. Next, cut away surplus using a table saw. Using a ¾-in. core box bit, make several passes to approximate the molding's shape. Readjust the cutter height and the fence after each pass.

Finally, use the jig shown to support the workpiece while smoothing the concave surface with a medium-fine belt. Clamp the jig securely to the sander stand top and sand along the cove by hand to remove any scratches.—*Ralph S. Wilkes*

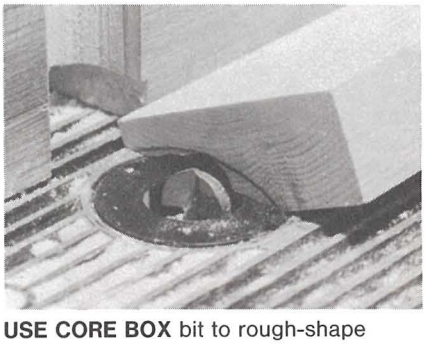




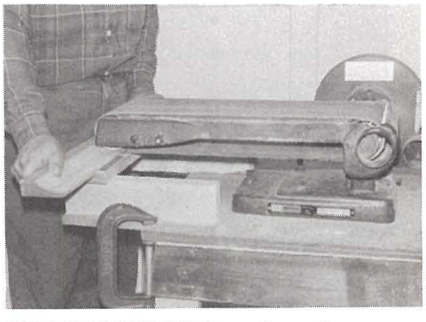

4
BELT SANDER
USING SANDING JIG TO SUPPORT MOLDING, SAND CONCAVE SURFACE WITH MEDIUM-FINE PAPER, MOVING JIG LENGTHWISE. FINISH BY SANDING LENGTHWISE BY HAND.
MOLDING
SANDING JIG



SANDING JIG ASSEMBLY VIEW



USE CORE BOX bit to rough-shape molding. Adjust bit and fence for each pass.



SUPPORT MOLDING on jig and move laterally against belt sander.

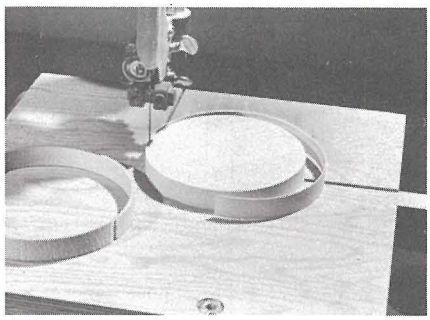
SUPER CIRCLE-CUTTING JIG

Use this circle cutter to make small-diameter toy wheels, gear blanks and the like. The jig rests on a bandsaw table and is engaged by a bar (D), in the miter groove and a stop (C), against the table edge. The workpiece rotates on a pivot pin (E) which can be positioned as required by diameter. A thumbscrew (F) locks the sliding bar (B) after the desired radius is determined.—*Walter N. Fritts*

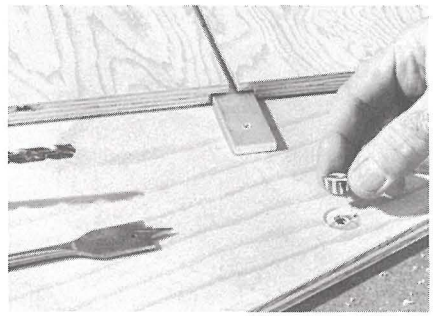
MATERIALS LIST—JIG

Key	No.	Size and description
A	2	½ × 16 × 16" plywood
B	1	¼ × 1 × 8" aluminum flat stock
C	1	¼ × 1 × 1¼" aluminum flat stock
D	1	⅛ × ¾ × 14" aluminum flat stock
E	1	10-32 screw (position as required)
F	1	¼-20 × ¾" thumbscrew
G	1	¼-20 × 1⅛" thumbscrew and washer
H	2	¼-20 Teenut
I	2	No. 8 × ½" fh wood screw

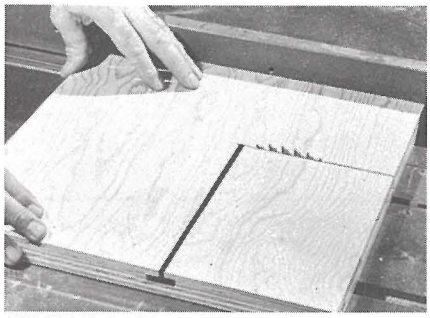
Misc.: White glue.



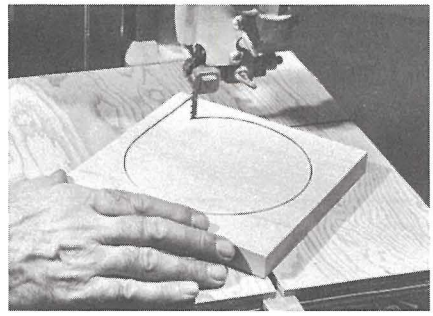
SLIDE BAR with pivot pin can be adjusted to cut very thin sections. Strip being cut is less than 1/16-in. thick.



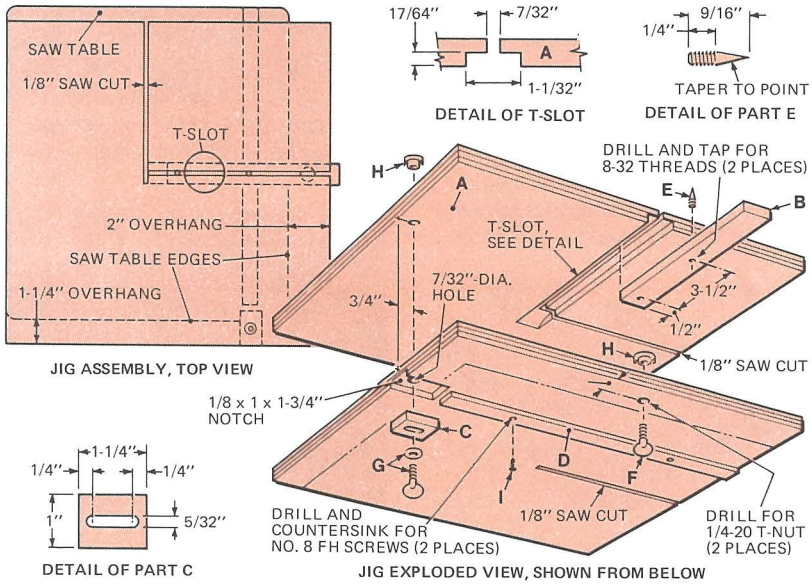
COUNTERBORE hole for Teenut so top of nut is flush to surface. Install Teenut *before* gluing two boards together.



MAKE ⅛-in. blade-entry kerf after T-slot has been cut and boards are glued. Use handsaw to finish cut.



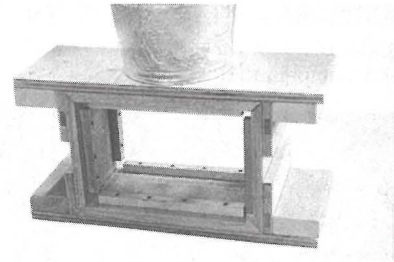
WHEN CUTTING, stop C may be adjusted to correct tracking of blade. Use ⅛-in. blade for diameters less than 3 in.



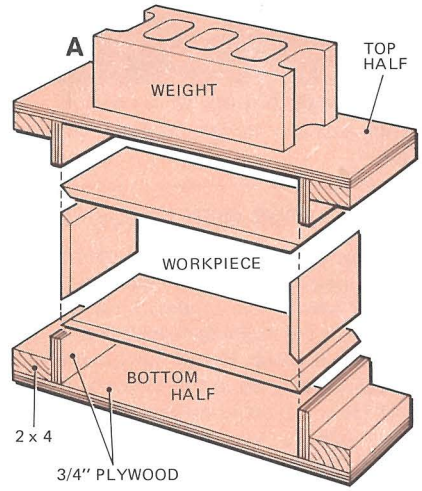
TWO MITER CLAMPS

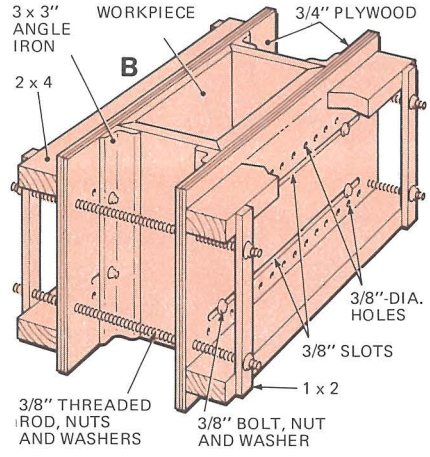
Clamping and gluing 90° miter joints, such as those used for speaker enclosures and wooden boxes, is difficult because force is needed in perpendicular directions. One simple solution is the upper jig shown below. It can be built quickly of scrap wood to suit the task at hand. Use a bucket of water, a cinder block or a couple of full gallon paint cans to provide the pressure.

The improved version (bottom) is adjustable and is a handy item to keep around the shop. It uses threaded rods to provide clamping pressure and does not need weights.—*Thomas Gibson*



CLAMPING JIG (above) must be sized to the project, unlike the adjustable jig.

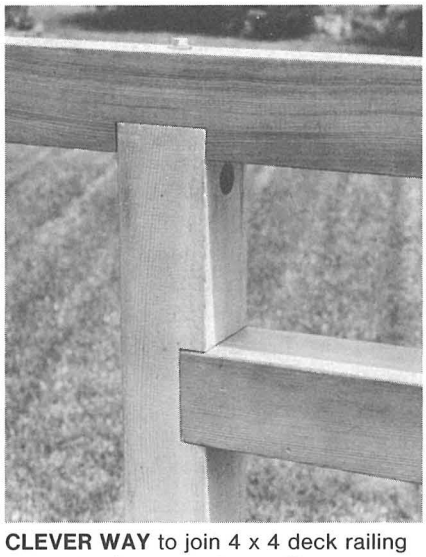




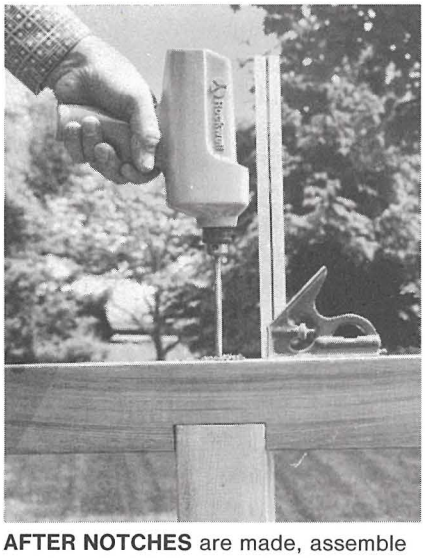
STURDY JOINT FOR DECK RAILING

Here's a good method for assembling a 4 x 4 railing—it's neater than nailing and holds better. As the lumber weathers and dries out, the lagbolts can easily be drawn tighter to keep the joints closed.

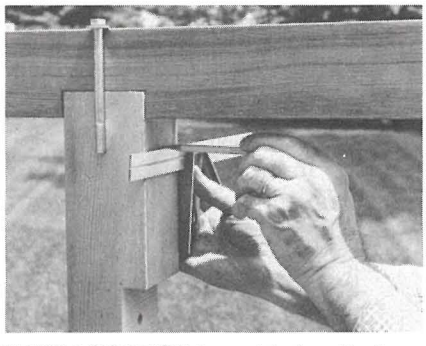
Using a square to guide the drill, bore bolt holes. Mark the location for the intersecting hole for the nut. Tape the drill bit to guide its depth and bore second hole (large enough to permit insertion of a nut and washer). Tighten the bolt firmly. Once the washer bows under pressure, it will prevent the nut from turning and will lock it firmly in place.—*J. Edwards*



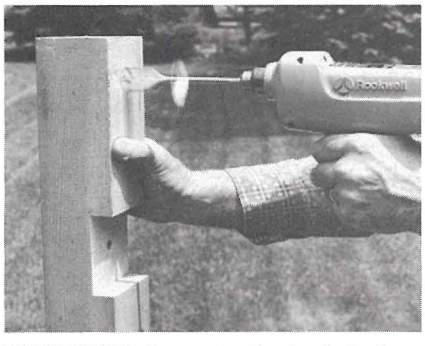
CLEVER WAY to join 4 x 4 deck railing or fencing is neater than nailing.



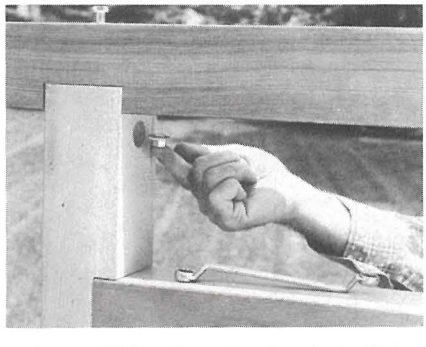
AFTER NOTCHES are made, assemble and bore bolt hole through rail into post.



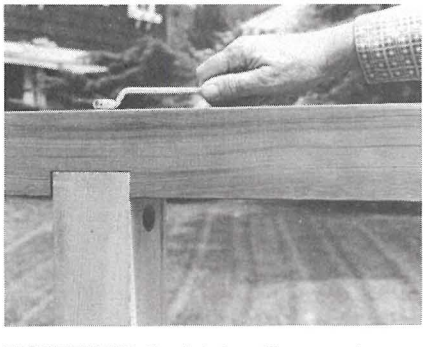
MARK LOCATION for nut hole, aligning center with the threaded bolt portion.



BORE NUT hole perpendicular to bolt hole. Use tape marker as a depth guide.



INSERT NUT and washer into hole (1-in. dia. for ¼-in. bolt); thread on the bolt.



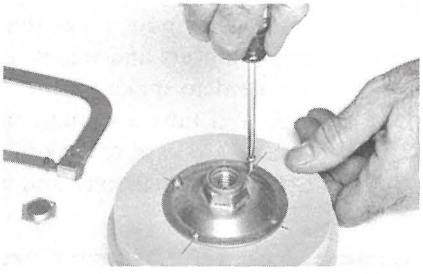
TIGHTEN UP the joints with wrench only after all members are in position.

HOMEMADE FACEPLATE

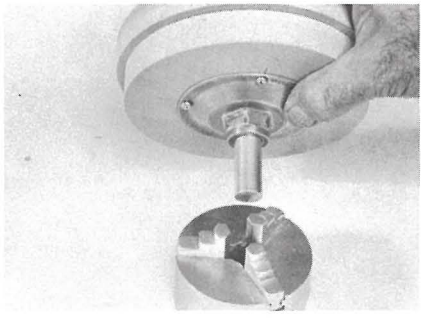
The metal hub of a saucer-type grinding disc can be converted to a faceplate. Wearing goggles. chisel away the ring of metal rolled over the abrasive in the center of the disc. When enough metal has been removed, a few raps on the disc will separate it from the hub. Also remove the epoxy in the hub.

Any damage to the hub's threads is corrected by starting a ⅝-11 tap from the healthy end. Drill three or four equally spaced holes in the flange for workpiece fastening screws. Then select a short ⅝-11 bolt and hacksaw off all but ¾ in. of threads and 1¼ in. of shank. Screw into hub.—*George Obradovich*

DRILL EQUALLY spaced holes in flat area of the flange after center has been completely cleaned out.



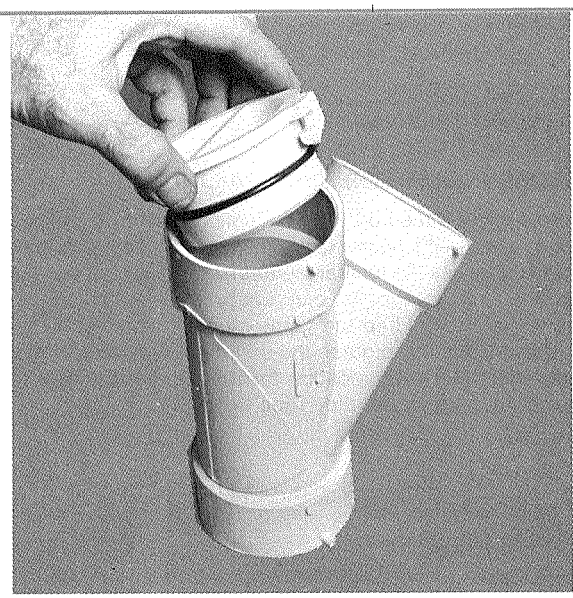
SCREW the faceplate to the work. Then saw off the head and tail of a ⅝-11 bolt to serve as the shaft.



SCREW BOLT into hub and faceplate is ready to use. Secure the shank in a universal for turning.

Do your own plumbing with plastic

By ROSARIO CAPOTOSTO



TWIST-LOK PLUMBER'S cleanout fitting by Genova fits easily without tools and seals tightly with a twist. Slotted ears hook over pins in drain-waste-vent hubs.

THE USE OF PLASTIC to manufacture plumbing pipe, tubing and fittings has made household plumbing jobs much less formidable for do-it-yourselfers. Plastic materials are less expensive than metal and don't require special tools.

Hardware stores and building-supply houses stock plastic plumbing supplies. The fittings, with instructions, come in transparent packages for quick identification. Items for some projects are available in kits containing all needed parts. Products are adaptable to fit existing plastic, copper, brass or iron pipe systems.

Several types of plastics are used to make these plumbing parts. Five common plastics are polypropylene (PP), polybutylene (PB), polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC), and Celcon. These are intermixed in the two branches of home plumbing: potable water supply and waste disposal.

A typical water-supply system has hot-and cold-water main pipes that branch off to sinks, tubs, showers and toilets. CPVC and PB plastics are used to make piping or tubing. (The terms pipe and tube are interchangeable.) CPVC and Celcon are used to make fittings.

CPVC pipe is rigid and is cut with a fine-tooth saw. You apply solvent to each part and press parts together to solvent-weld them.

PB is a relative newcomer in the plastic-plumbing field. It's the first flexible tubing approved for hot-water service.

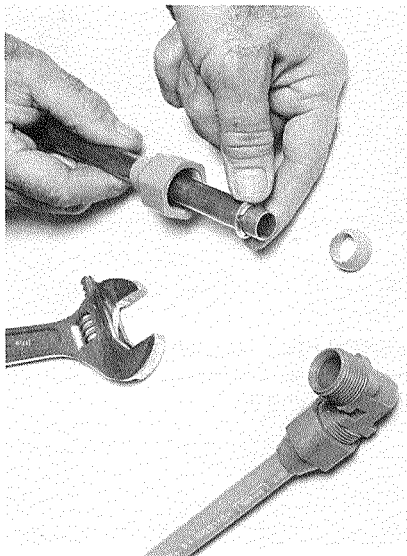
The flexibility of PB permits it to be fished through structural members and behind partitions and hard-to-reach places, making it a boon to remodelers. Precise measurement of PB for runs and risers isn't essential. The tube flexibility also cuts down on the number of fittings required; it bends around corners. PB absorbs shocks so that water hammer doesn't occur.

You can cut PB with a knife or plastic-tubing cutter and make connections by simple mechanical means.

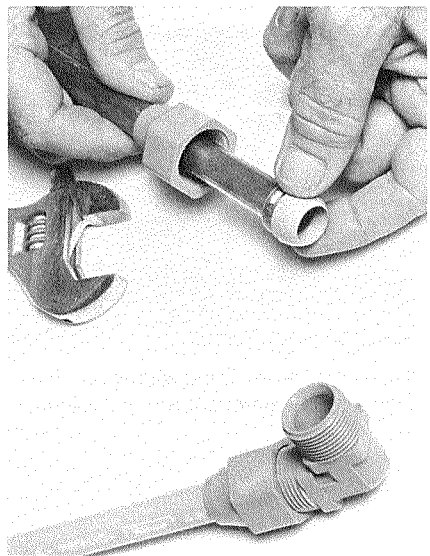
Both CPVC and PB conserve energy by retarding heat transfer. In cold-water piping, this reduces sweat-dripping during hot, humid weather. Neither material corrodes nor is prone

HERE'S HOW TO CONNECT COPPER AND PB PIPE

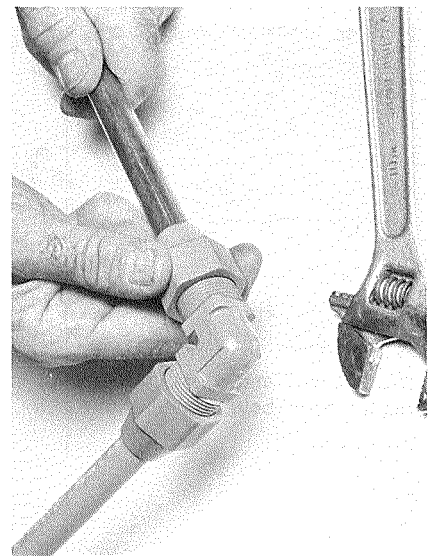
SLIP a plastic nut (Qest is shown) over copper tubing; then slip on metal ring.



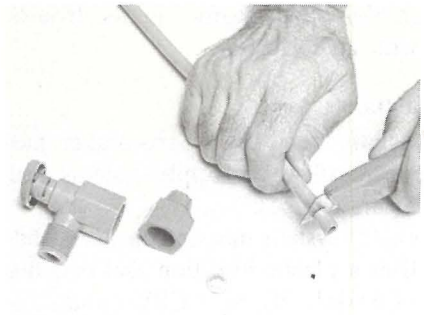
NEXT, slide the seal cone (the large end first) over the copper tubing.



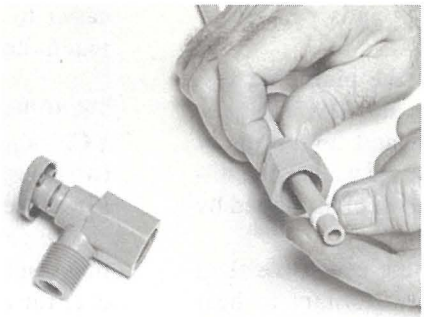
SLIDE the nut onto the threaded fitting. Tighten by hand, then with a wrench.



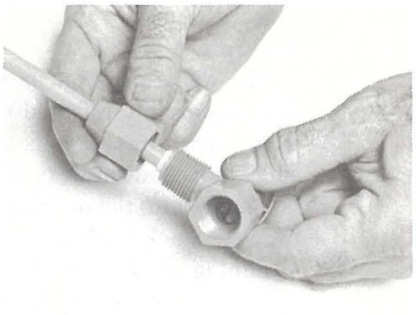
QUICK WAY TO CONNECT TO AN ANGLE VALVE



TO MAKE Qest basin-supply connection to angle valve, first cut tube to length.



SECOND, slip the nut over the supply tube; then slip on the compression ring.

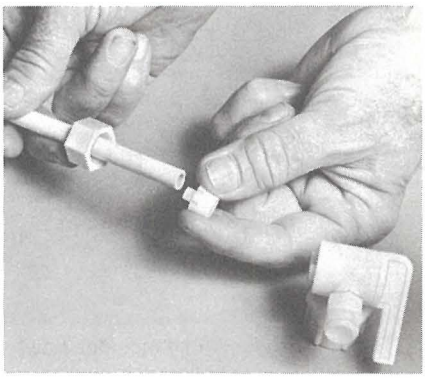


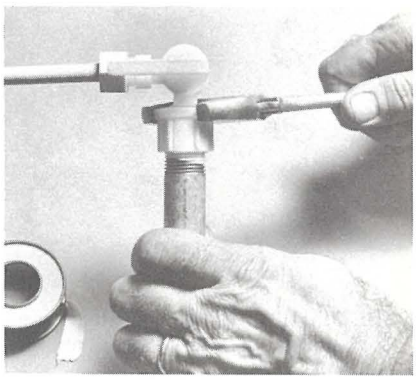
THIRD, insert the tube end into the valve and tighten assembly securely. Procedure is the same for copper tube.

HOOKING UP TO A VALVE

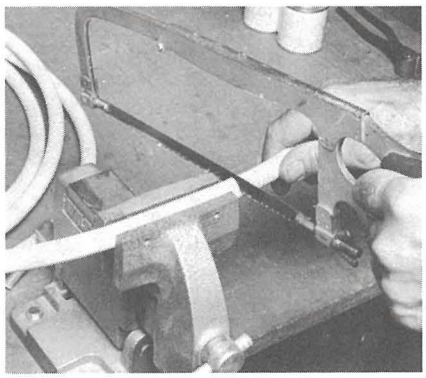
TO MAKE a Connex-All basin supply connection to a valve (right), cut supply tube to length with a knife, slip nut over the tube and insert compression fitting into the end of the tube. *Note:* This connection can be made without disconnecting the nut from the tube.

WHEN the valve is to be connected to a threaded pipe (far right), first wrap the threads with Teflon tape to assure a watertight joint.



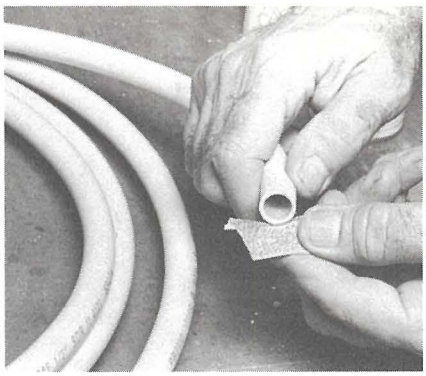


YOU 'WELD' THIS CONNECTION WITH SOLVENT



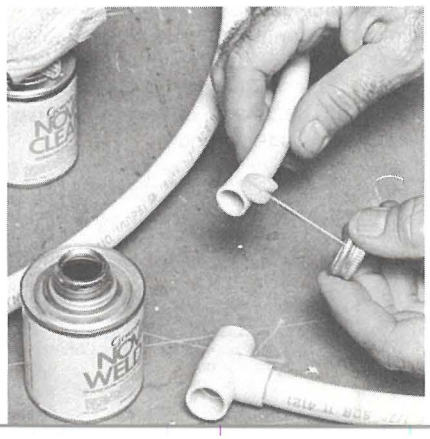
TO SOLVENT-WELD Genova CPVC pipe, first cut it squarely with a fine-tooth saw.

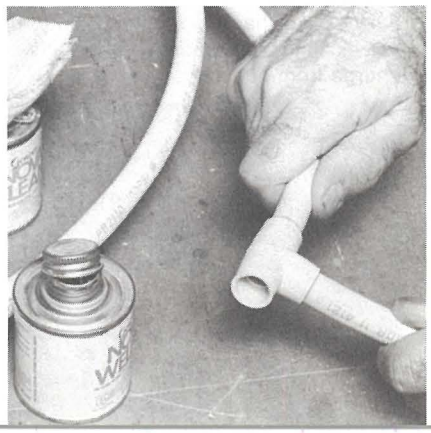
THIRD, wipe the parts with cleaner and apply solvent to pipe and socket.



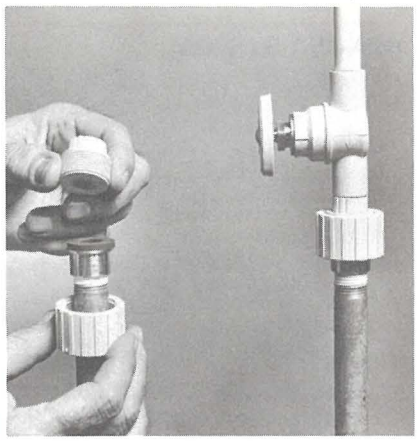
SECOND, use sandpaper or a knife to remove all burrs on the pipe end.

FOURTH, push pipe into socket with a slight twisting motion until pipe bottoms.





GENOVA HOOKUP



TO HOOK UP CPVC to water heater with Genova transition fittings, slip nut on heater nipple. Thread brass fitting onto Teflon-wrapped nipple and tighten.

MANUFACTURERS LIST

Chicago Specialty Manufacturing Co., 7500 North Linder St., Skokie, IL 60076
Genova Inc., 7034 East Court St., Davison, MI 48423
Qest Products Inc., 1900 West Hively, Box 1746, Elkhart, IN 46515

to lime-up. Pressure and high-temperature resistance ratings are about 100 pounds per square inch (p.s.i.) at 180° F.

The waste-disposal part of the plumbing system, commonly referred to as the DWV (drain-waste-vent), has various traps and tubing under sinks, tubs and showers. These, as well as the toilet, empty into the main stack, which is topped by the vent stack leading outside.

Tubing made with PP is less expensive than traditional brass and is highly resistant to heat and the corrosive action of household chemicals and drain cleaners.

Waste and vent piping made of PVC is less costly than traditional galvanized metal and is easier to assemble with leakproof joints. It lasts indefinitely, with no corrosion.

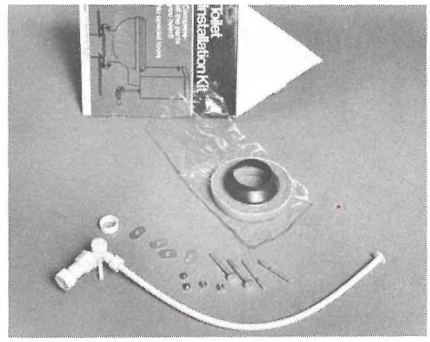
major manufacturers

• **Chicago Specialty,** one plastic-parts maker, has two lines: Connex-All water-supply systems and Fit-All tubular drain pipes.

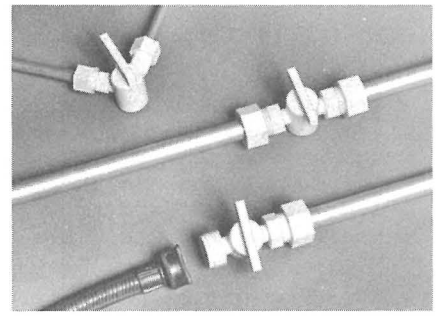
The Connex-All system has Celcon acetal fittings and utilizes a plastic insertion seal that fits over the end of flexible PB, rigid CPVC and flexible or rigid copper.

Fit-All tubular drain parts combine PP and PVC for kitchen and bathroom use. All bend

THE PLUMBING-PARTS system from Chicago Specialty includes all fittings for water supply and waste drain. PB tubing and kits with parts for sink and toilet installation are also available.



TOILET installation kit includes bowl wax with plastic collar, angle valve, flexible water-supply tube, bolts and screws.

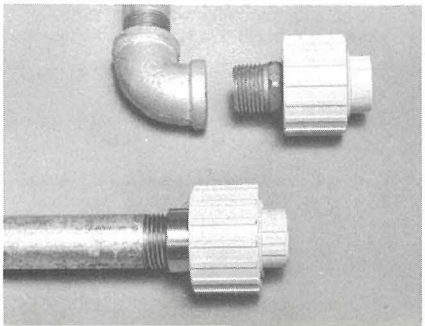


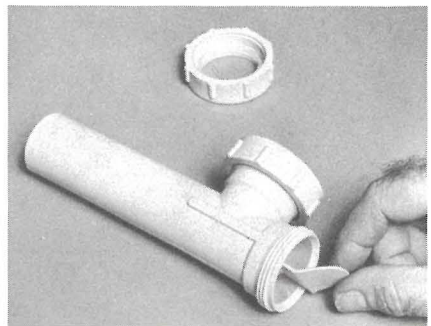
SOME Chicago Specialty hookups are (from top): ¼ to ¼-in. PB tubing; ½ to ½-in. copper tubing; ½-in. copper pipe to hose. Tubing can be PB, copper or CPVC.

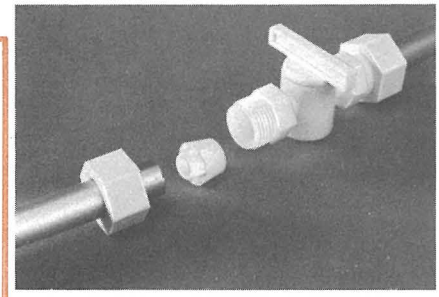
GENOVA SYSTEM

TRANSITION unions by Genova permit male and female pipe thread hookups that can be disassembled without cutting the pipe.

GENOVA baffle tee connects garbage-disposal discharge into sink drain to utilize existing trap. Baffle prevents discharge from backing up into sink.

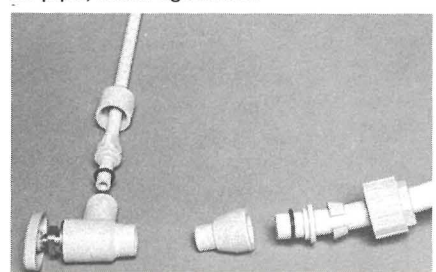






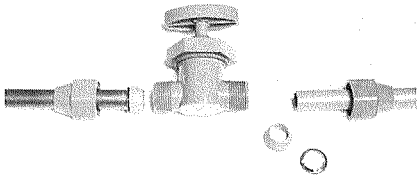
TO MAKE a typical Chicago Specialty connection, loosen nut and push plastic or copper tubing into fitting. Then tighten nuts with wrenches. Connector is shown disassembled for clarity only.

THE GENOVA angle stop (left) adapts mechanically to ⅜-in. o.d. PB tubing (top). Genogrip adapter (right), shown disassembled, solvent-welds directly into fitting and permits joining PB tubing mechanically by clamping a tapered split-grab-ring and rubber O-ring around pipe. In use, adapter is pushed on pipe, hand-tightened.

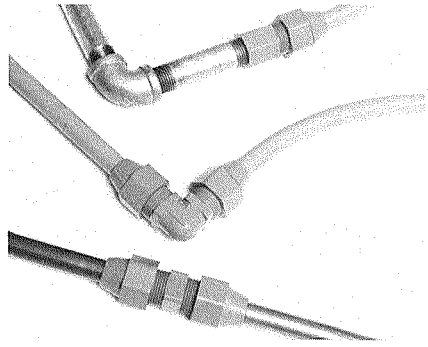


QEST PLUMBING SYSTEM

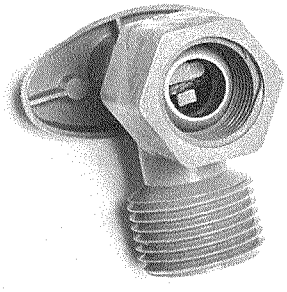
QEST system includes the needed parts for water-supply plumbing. Flexible PB tubing comes in straight lengths and coils. Fittings and valves are of Celcon, a tough, rigid plastic that holds up under a wrench. The system is known as Qicktite. It uses an end-compression connection.



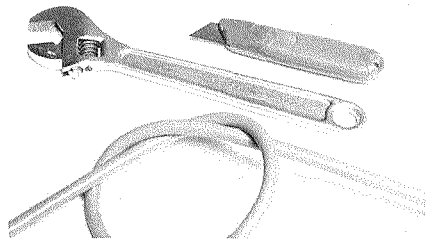
IN THE QEST hookup, a nut, ring and cone slip over pipe and thread onto fitting. The nut is tightened to seal. The system is used on copper, PB or CPVC.



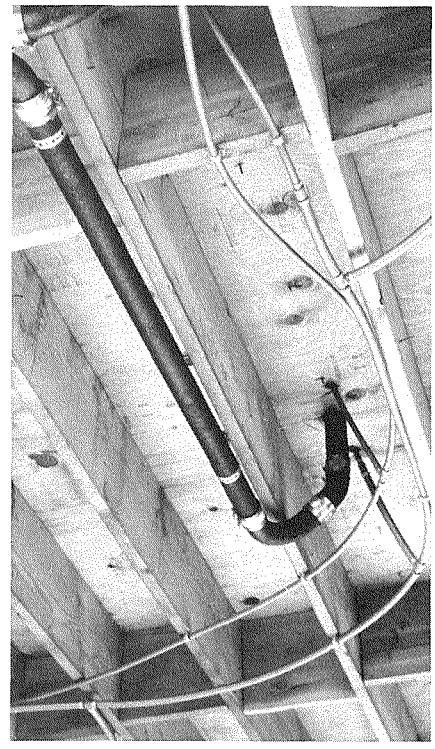
THESE QEST connections are (from top): PB coupled to a threaded pipe; right angle bend of PB tubes; copper tubes coupled.



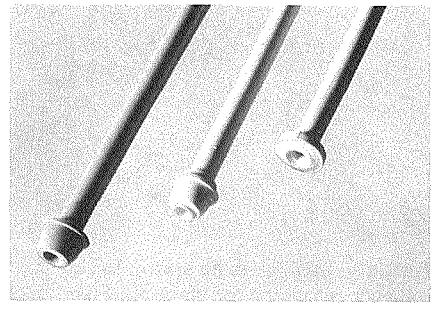
SEALING CONE is built into Qest female fittings and valves. The cone eliminates the need for thread dope or tape.



POLYBUTYLENE TUBE (foreground) is bent to 10 times its diameter without kinking. For example, a ½- to ⅝-in.-dia. tube can be turned in a 5- to 6-in. radius. Wrench and knife are used on Qest system.



WHEN FLEXIBLE PB tubing is used, corners can be negotiated.



MOLDED FAUCET ends of PB riser tubes won't come apart. Risers shown (left to right): Qest, Genova, Chicago Specialty.

sections are made with highly heat resistant PP. Combination kits to install water-supply and drain systems in kitchen and bathroom sinks are available.

• **Genova,** another plumbing-materials maker, has a full line of plumbing and pipe fittings. For water-supply systems, products include CPVC tubing and fittings and PB tubing. For waste-disposal systems, Genova makes PVC pipe and fittings and PP tubular items such as waste arms and traps.

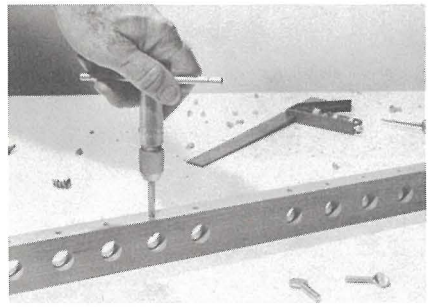
• **Qest** (pronounced "kest") specializes in water-supply plumbing utilizing flexible PB tubing and Celcon fittings and valves. Celcon is a rigid, tough plastic that has optimum wrenching strength. The system uses an end-compression connection, a conventional-looking male fitting with threaded ends.

4 great projects for your shop

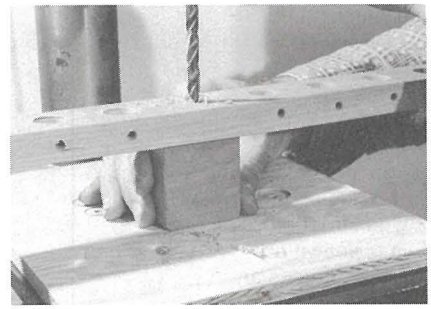
AUTOMATIC CENTER FINDER

By ROBERT BESSMER

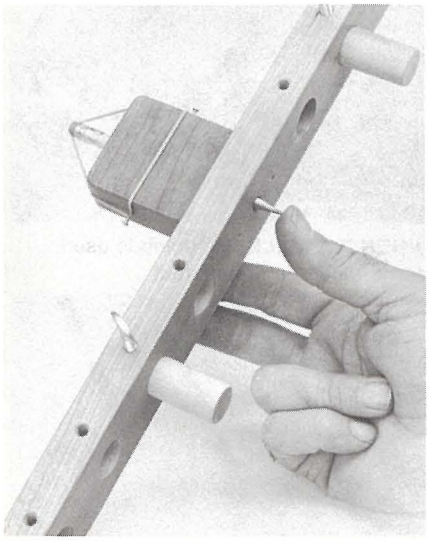
IN USE, pencil marks centerline when gauge straddles workpiece and pegs remain in contact with board's edges.



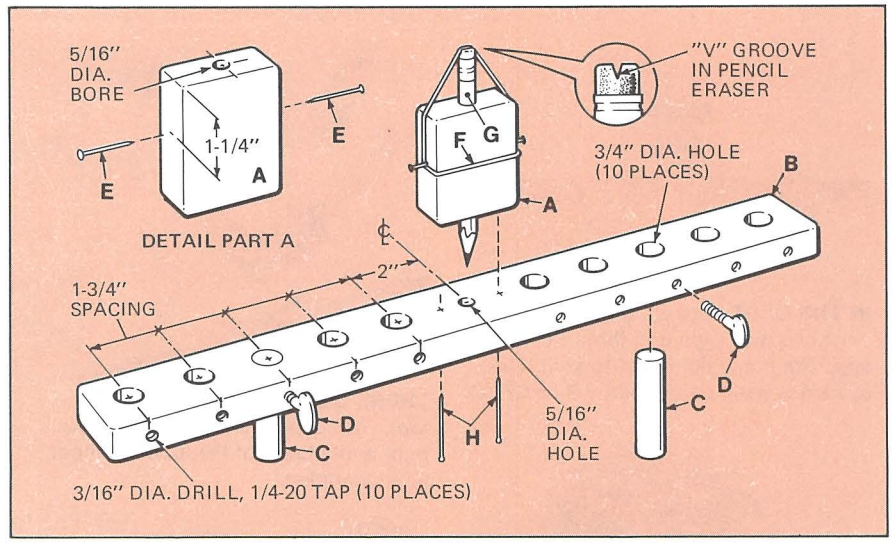
TAP THE 3/16-in. holes in the center finder's edge for thumbscrews which lock guiding ¾-in. dowels in position.



USE DRILL PRESS to bore 5/16-in. center hole, as well as ¾-in. dowel holes. All holes *must* be centered.



RUBBER BAND acts as spring to put pressure on pencil for marking. Fixed pencil would make finder arm rock.



■ THIS HANDY TOOL finds centers and marks centerlines on boards and panels up to 17 in. wide. To use it, adjust pegs (C) to suit board width as closely as possible, and pivot arm (B) until the pegs press against the edges of the workpiece. The spring-loaded pencil will mark the center.

Keep in mind these tips:

1. Each dowel hole must be bored precisely the same distance from the pencil hole as the corresponding hole on the opposite side.

2. All holes must be perfectly centered.

3. Use a brad-point bit in your drill press to bore holes accurately.

4. Use a thin, weak rubber band (No. 18). A V-notch cut into the tip of the eraser or a tack will hold the rubber band in place.

MATERIALS LIST—CENTER FINDER

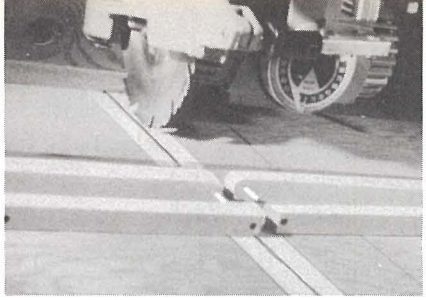
Key	No.	Size and description (use)
A	1	1-1/16 x 1-3/4 x 2-1/2" hardwood (pencil block)
B	1	1-1/16 x 1-3/4 x 20" hardwood (arm)
C	2	3/4"-dia. x 2-1/4" dowel
D	2	1/4-20 x 1" thumbscrew
E	2	1" escutcheon
F	1	No. 18 rubber band
G	1	pencil with rubber eraser
H	2	6d finishing nail

Misc: White glue, tack (optional), oil finish (optional)

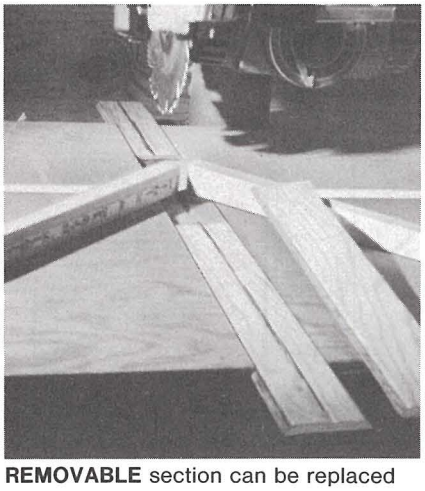
PIVOTING RADIAL-SAW RIP FENCE

By DR. C. D. SMITH

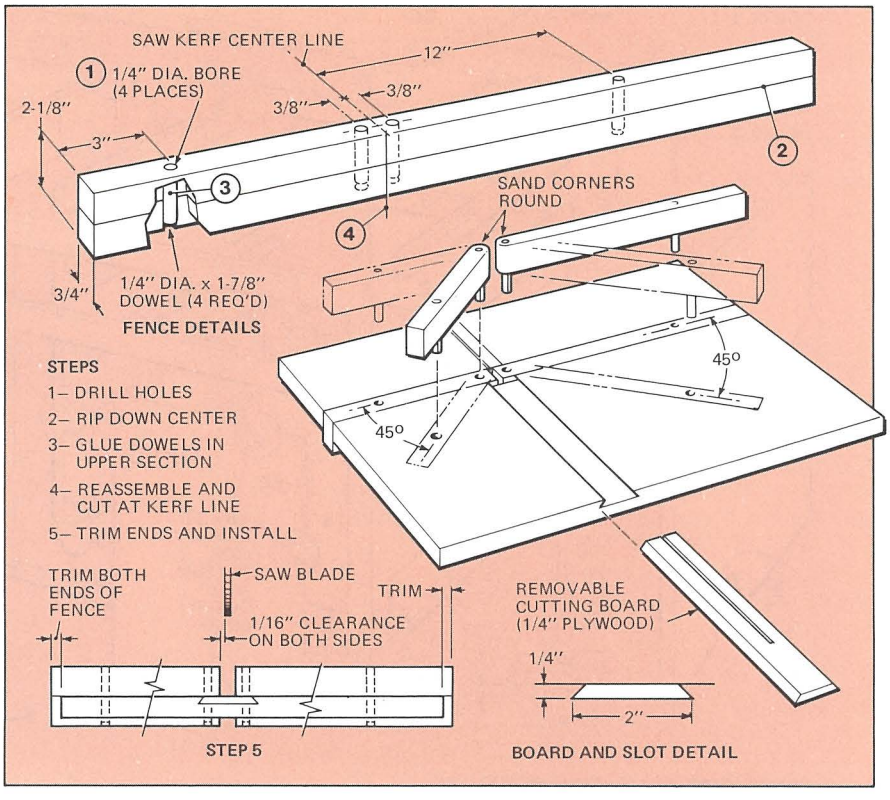
■ THIS VERSATILE, long-lasting fence pivots and can be adapted to cut any right- or left-hand angle. To build it, cut a board the length of your saw table. Install it in the table slot and mark the location of the saw blade's path. Next, lay out and centerpunch the four holes to be bored (see plans). Use a drill press to bore holes and then rip the fence in half lengthwise. Glue dowels into



HARDWOOD FENCE has dowel hinges which allow it to pivot for cutting angles.



REMOVABLE section can be replaced after many cuts.



holes in the top half of the fence, letting them protrude at the bottom. When they're dry, align the dowels with holes in the bottom fence half and assemble. Cross cut the assembly at the blade path mark.

Clamp the fence halves into the table slot and install your widest-kerf-cutting blade. Then slide the fence sections to allow 1/16 in. blade clearance. Mark the fence ends flush with the table ends, remove and trim. Slightly round the corners at the pivoting ends of the fence.

If desired, a rule can be marked on each fence section. The tapes from a discarded tape measure can also be used. Cut tape at the 1-in. mark and fasten it to the fence section, so that the tape begins precisely 1 in. from the blade.

To lay out holes in the saw table which lock the fence for cutting at 45° or at another angle, pivot the fence into the angle position, mark the hole, centerpunch and bore.

Note: When using your saw to cut bevels and compound angles, slide fence to the right, so that the blade will pass through the opening.

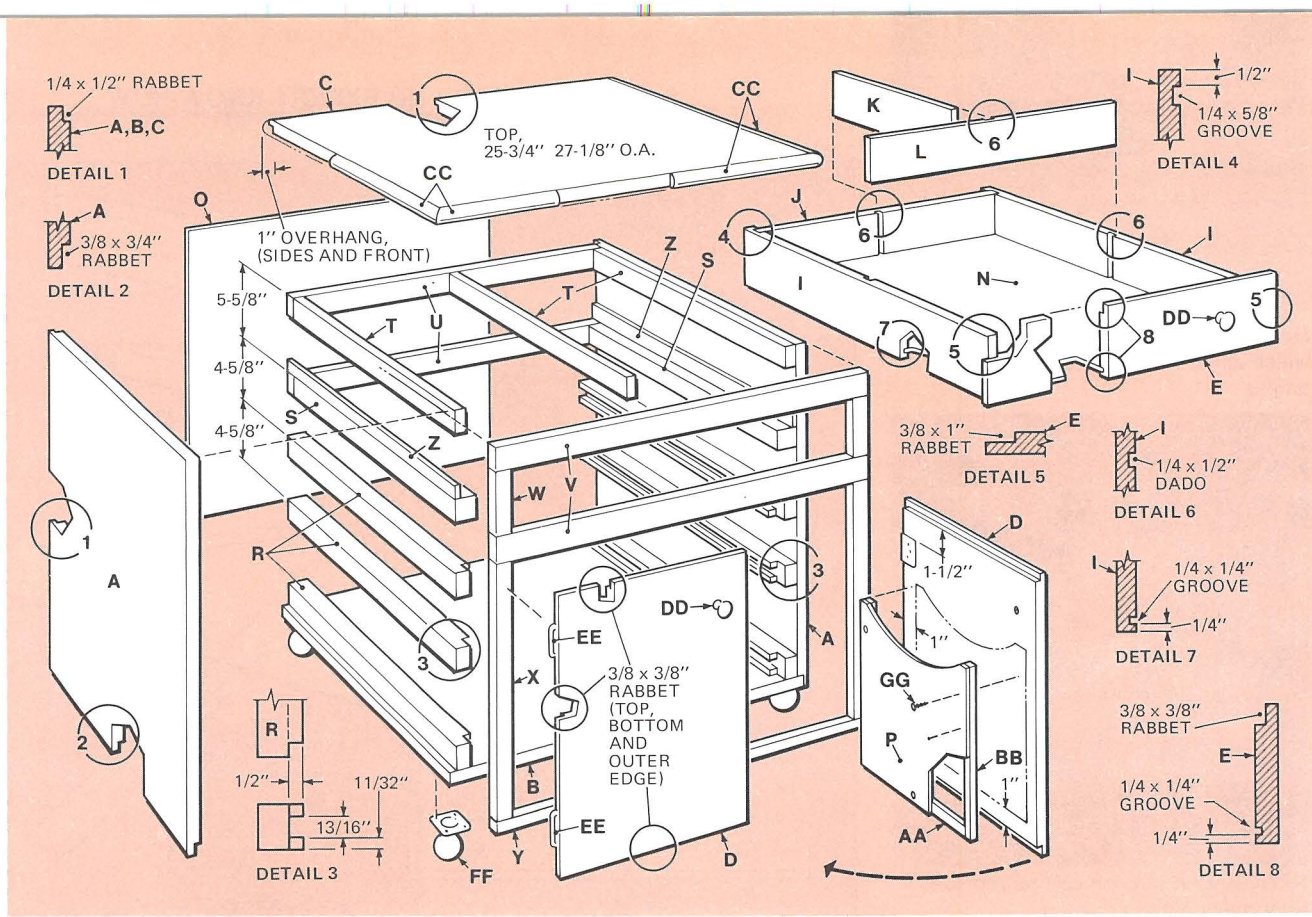
MOBILE ACCESSORY OR TOOL CABINET

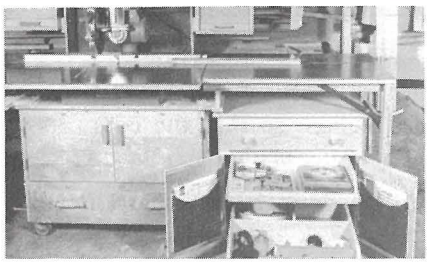
By C.E. BANISTER

■ THIS MOBILE CABINET was designed to store accessories for a radial-arm saw. It was sized to fit under a specific saw, but the dimensions can be altered to fit your saw. The cabinet can also be used to store an assortment of portable power tools. Casters let you roll the cabinet to any work station.

how to build the cabinet

Construct the cabinet as shown in the plans. Install the pull-out shelf slides and the drawer slides prior to joining the sides (A) and back (B) to the top (C). Use glue and finishing nails to



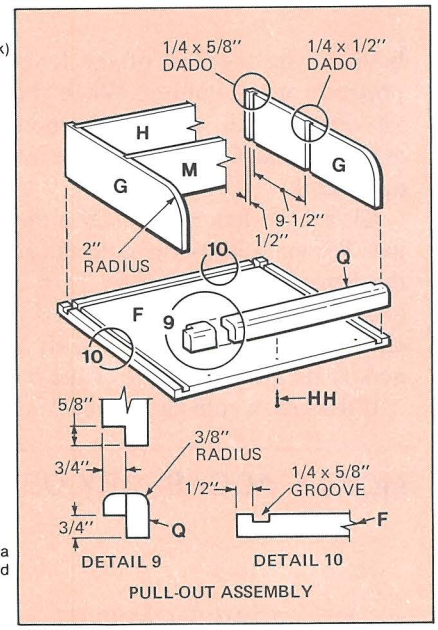


ACCESSORY CABINET can be parked under extension to radial-arm saw. Parts G2 and H2 (not shown in drawing) refer to bottom pull-out tray dimensions.

MATERIALS LIST—MOBILE CABINET

Key	No.	Size and description
A	2	3/4 x 23-3/8 x 24" plywood
B	1	3/4 x 24 x 24-5/8" plywood
C	1	3/4 x 25 x 26-1/8" plywood
D	2	3/4 x 11-7/8 x 16-1/8" plywood
E	1	3/4 x 4-3/8 x 23-3/4" plywood
F	3	3/4 x 21-1/2 x 22" plywood
G1	4	5/8 x 3-1/2 x 22" pine (planed from 3/4" stock)
G2	2	5/8 x 4-3/4 x 22" pine (planed from 3/4" stock)
H1	2	5/8 x 3-1/2 x 19-3/4" pine (planed from 3/4" stock)
H2	1	5/8 x 4-3/4 x 19-3/4" pine (planed from 3/4" stock)
I	2	5/8 x 4 x 23" pine (planed from 3/4" stock)
J	1	5/8 x 4 x 22-1/4" pine (planed from 3/4" stock)
K	1	1/2 x 3-1/2 x 10" plywood
L	1	1/2 x 3-1/2 x 22-1/4" plywood
M	3	1/2 x 3-1/4 x 19-3/4" plywood
N	1	1/4 x 22 x 22-1/4" plywood
O	1	1/4 x 22-7/8 x 24-5/8" plywood
P	2	1/8 x 10 x 10-1/2" pegboard
Q	3	1-1/2 x 1-1/2 x 20-1/2" fir or pine
R	6	1-1/2 x 1-1/2 x 23-3/4" fir or pine
S	2	1-1/2 x 1-1/2 x 23" fir or pine
T	3	3/4 x 1-1/2 x 23" fir or pine
U	2	3/4 x 1-1/2 x 25-5/8" fir or pine
V	2	3/4 x 1-1/2 x 25-1/8" fir or pine
W	2	3/4 x 1 x 4-1/8" fir or pine
X	2	3/4 x 1 x 15-1/2" fir or pine
Y	1	3/4 x 3/4 x 25-1/8" fir or pine
Z	2	1/4 x 3/4 x 23" fir or pine
AA	4	1/2 x 1/2 x 10-1/2" fir or pine
BB	2	1/2 x 1/2 x 9" fir or pine
CC	as reqd.	3/8 x 3/4" half round
DD	4	1"-dia. wood pulls
EE	4	3/8" offset, self-closing cabinet hinges
FF	4	2"-dia. plate-type casters
GG	6	No. 6 x 1" fh screw
HH	9	No. 12 x 1-1/4 fh screw

Misc: White glue, finishing nails as reqd., zip clips for extra partitions (zip clips are available from Craftsman Wood Service, 2727 South Mary St., Chicago, Ill. 60608).



make the final assembly. Check for squareness as you go.

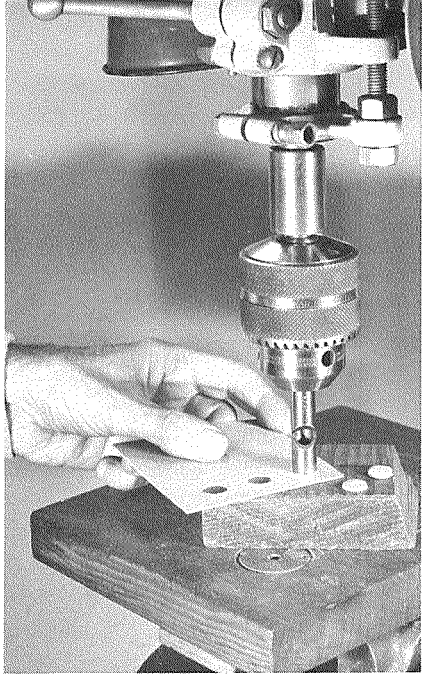
Next, make the drawer and pull-out shelves. The dividers can be arranged to suit the tools which you will be storing.

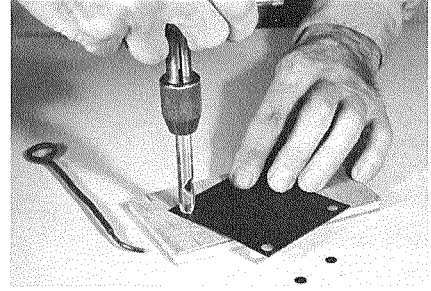
Additional ¼-in. dividers may be added after assembly by using zip clips (see materials list).

Make the cabinet doors with a standard ⅜-in. rabbet along three edges. The door pockets have perforated hardboard fronts to allow you to blow out dust that may collect inside. Be sure there is sufficient clearance for the door to close completely. The drawer slide ends must be notched as shown in the plans to avoid interference with the door pockets.

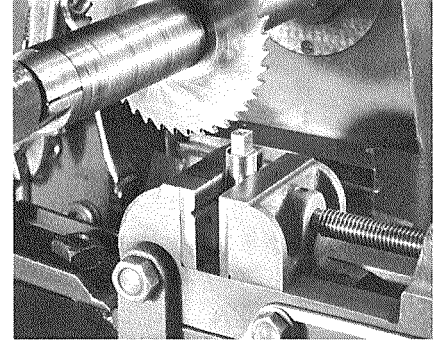
The choice of hardware is optional. We used wooden knobs with self-closing, ⅜-in. offset hinges.

Finally, add plate-type casters to the ¾-in. plywood bottom and coat with clear, gloss polyurethane for a durable finish.

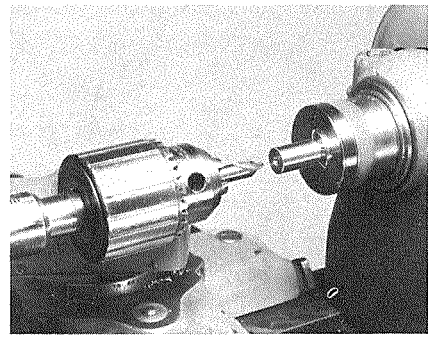




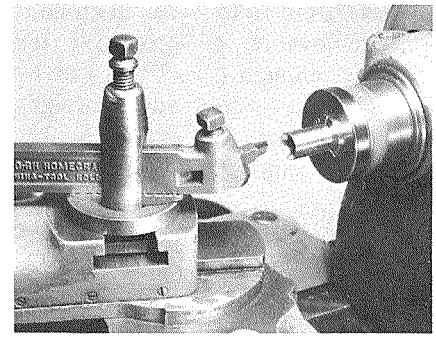
ROTARY PUNCHES can cut ½-in. holes in cardboard with a drill press (left), or ¼-in. holes in leather by twisting punch in tap wrench (above).



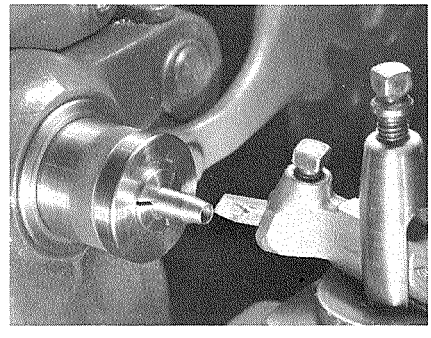
AFTER CUTTING blank for punch, mill tip so punch can be used in tap wrench.



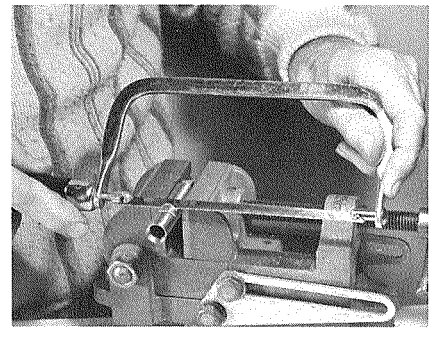
USE A CENTER drill to insure precise start of twist drill in punch blank.



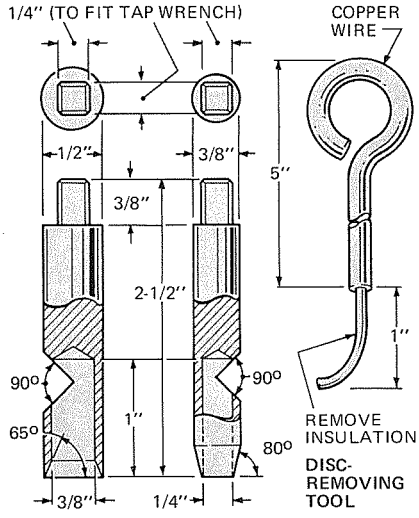
FOR MACHINING inside bevel, compound slide, set at 65°.



FOR OUTSIDE bevels, invert bit, set slide at 80° and feed against blank.



CUT NOTCH in punch with hacksaw to permit ejection of cut discs with a wire.



ROTARY PUNCH FOR NEAT HOLES

By WALTER E. BURTON

■ ROTARY PUNCHES make neat, round holes quickly in thin materials. Instead of pounding them to make them perform, they are rotated, either by hand or power, and act as clean-cutting circular knives.

The punches are made from high-carbon drill rod, to be used in a conventional tap wrench or a ½-in. drill press chuck. They can also be adapted for use in portable electric drills or hand-cranked drills.

A punch can be made with either an inside or outside bevel on the cutting edge. An inside bevel (see plans) will make holes equal to the cutter's diameter. Outside bevels will make discs or plugs to the cutter's diameter.

Begin making a punch by machining a blank true and flat at each end. Then square one end to fit a tap wrench, using a milling machine or by grinding or filing.

A collet chuck holds the punch for drilling and machining the bevels. Spot hole with a center drill. Then drill to the desired diameter. After the hole is made, use the lathe compound slide, set at 65°, for machining the inside bevel with a tool bit slender enough to enter the hole without dragging. For outside bevels, set compound slide at 80°, invert tool bit in its holder and feed into the punch blank from rear. Take successive cuts until a sharp cutting edge is formed. Then hone with an abrasive stone.

After the lathe work is done, clamp punch in a vise, and saw and file smooth a V-shaped notch at the shank-end of the bore. A handy tool made of No. 10 copper wire (see plans) is ideal for pushing out the cut plugs through the notch opening.

Harden and temper cutting end of each punch by heating to bright red and plunging it into cold water. Reheat the end until a straw color appears on a brightened area at the cutting edge; douse in water. Polish entire punch with abrasive flap wheel.

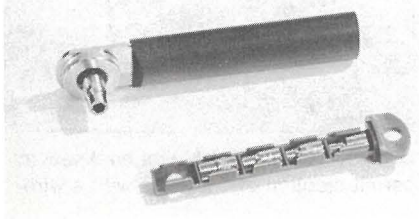
New for your shop

Prices shown for these shop products were in effect at the time this article was prepared.

POCKET SOCKET SET

This six-piece, ¼-in.-drive socket set features a handle that holds five sockets, from 3/16 to 5/16 in., in an integral, removable, spill-proof tray. It's compact enough (1½x7¾ in.) to be carried in a pocket, and it weighs just six ounces. The Pocket Socket has a removable thumbwheel

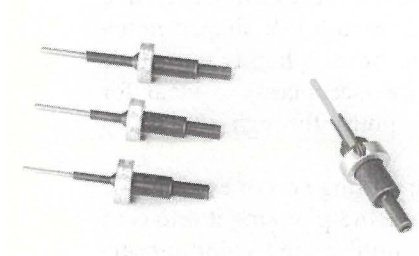
This well-built wrench set conveniently carries five sockets in its handle. It sells for under $20.



ratchet for tight jobs. It's about $18 at hardware and auto-supply stores, from Litton New Britain Tool, Box 1320, New Britain, CT 06050.

ADJUSTABLE PILOT DRILLS

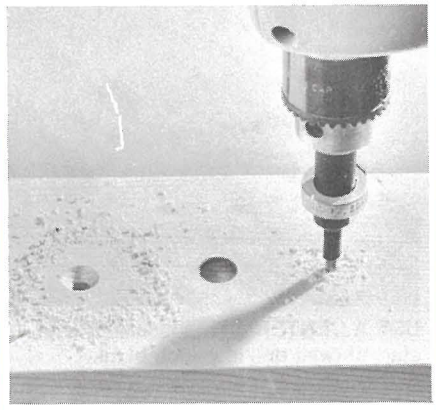
This set of completely adjustable pilot drills boasts four sizes to accommodate Nos. 5, 6, 7, 8, 9, 10, 12 and 14 wood screws in all common



Handy four-bit set replaces more than 30 bits in your drill box. It countersinks and counterbores.

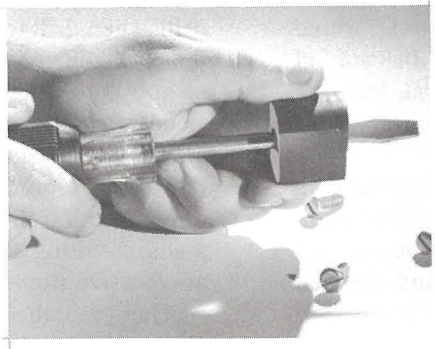
lengths up to 2 in. It is claimed to replace as many as 36 conventional pilot and countersink drills.

With simple adjustments, you can

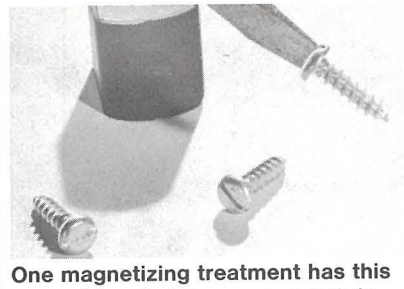


bore a pilot hole for the thread portion of the screw, a shank hole for the body, and countersink or counterbore in one operation. A stop collar permits repeat drilling to a set depth. Scru-Drill is manufactured by Disstim Corp, 207 West Evesham Rd., Runnemede, NJ 08078. It's available at hardware stores for about $14.

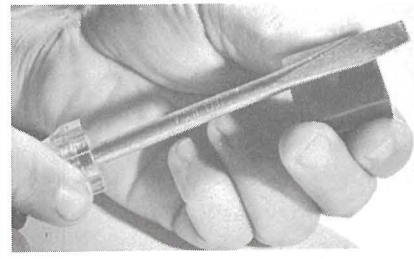
LOW-COST MAGNETIZER



No workshop or toolbox should be without a tool magnetizer/demagnetizer. This little beauty sells for $2.99 and takes up little space in a tool-box. When turning screws in hard-to-reach places, it can be slipped over the driver's shank for full magnetic power. It's sold at hardware stores or direct from Jay-Gee Manufacturing Co., 4191



One magnetizing treatment has this screwdriver holding screws tightly.

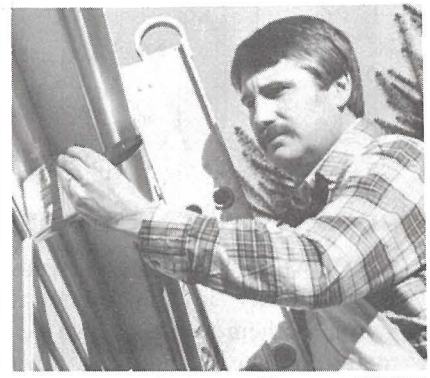


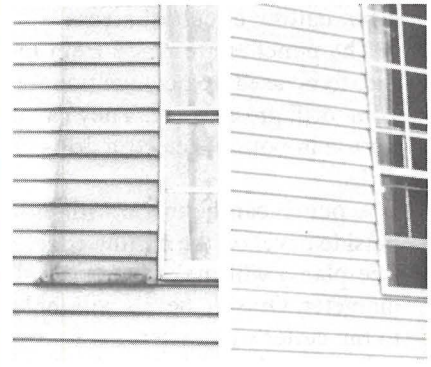
It's just as easy to demagnetize a tool: Just rub against the side.

Southwest 11th Terrace, Fort Lauderdale, FL 33315.

NEW FINISH FOR OLD SIDING

There's good news for those who installed aluminum or steel siding 15



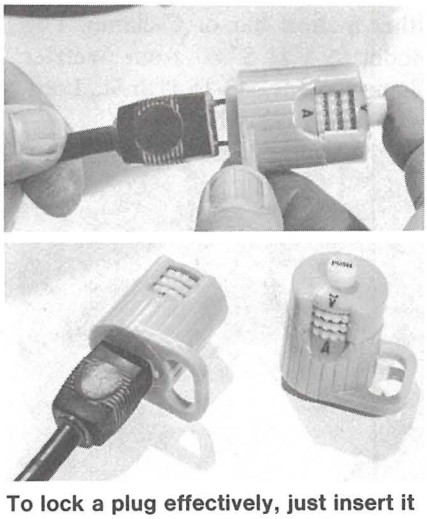


New Metal Siding Refinish can be applied by pad, spray or brush (top) to cover dull, dingy siding (above left) and make it look like new (right). It comes in exterior white and a mixable pastel base.

to 20 years ago. PPG Industries, manufacturers of PPG Paints, has introduced a new exterior finish designed expressly for aluminum and steel siding. The latex coating has unique film qualities completely different from conventional latex exterior paints, according to a PPG spokesman. The paint, called Metal Siding Refinish, can withstand the expansions and contractions of metal siding and has the strength and surface hardness to discourage mildew. It's about $20 per gallon at paint stores or write PPG Industries, 1 Gateway Center, Pittsburgh, PA 15222 for supplier.

A LOCK ON ELECTRICITY

This combination lock fits any standard 120-v. two- or three-prong electric plug. Rendering the plug inoperative, it effectively prevents unwanted hands from fooling with power tools, toasters, heaters and other potentially dangerous electrical appliances. (As a bonus, parents



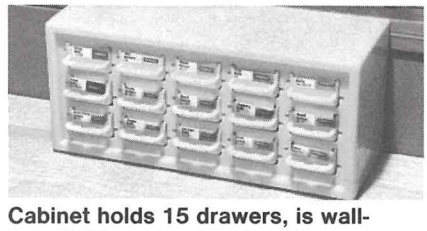
To lock a plug effectively, just insert it into the end of the device. In order to unlock and release the plug, you must first set the combination and then push the release button.

can lock the television power cord so junior will keep his nose in his books.) Lock-A-Plug comes with a five-year guarantee.

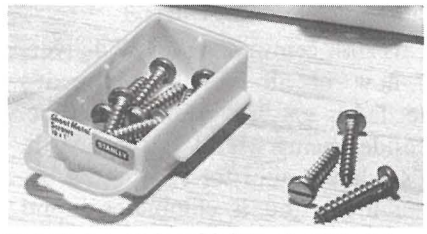
It can be purchased from the Meloworld Products Co., R.D. 1, Box 90-D, Slate Hill, NY 10973 for $6.95 postpaid.

STANLEY'S ASSEMBLY LINE

The Stanley Assembly Line is a new type of fastener storage system that is designed to let you customize your own fastener assortment. The maker offers more than 250 varieties in 24 categories of fastening hardware in



Cabinet holds 15 drawers, is wall-mountable or kept on bench.

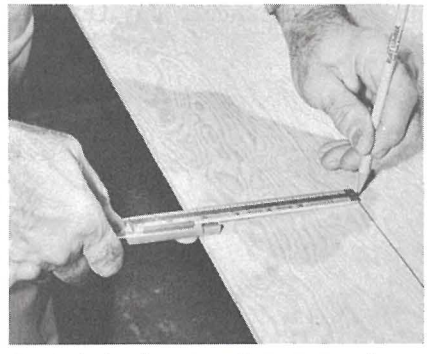


Plastic boxes in which fasteners are sold become drawers in cabinet.

convenient plastic boxes which serve as drawers. Drawers are labeled to identify contents quickly by name and size. The cabinet is sold separately for $1.79. From Stanley Hardware, Div. of the Stanley Works, New Britain, CT 06050

RULER GUIDE AIDS MARKING

If you've ever been jabbed by a splinter when using your thumb as a makeshhift marking gauge, you'll appreciate this new gadget. Its channel holds a folding rule, and a nylon roller rides against the workpiece. Available from Knight Tool Co., Box 150, Knox, PA 16232, it's $3.98 plus 50 cents shipping.

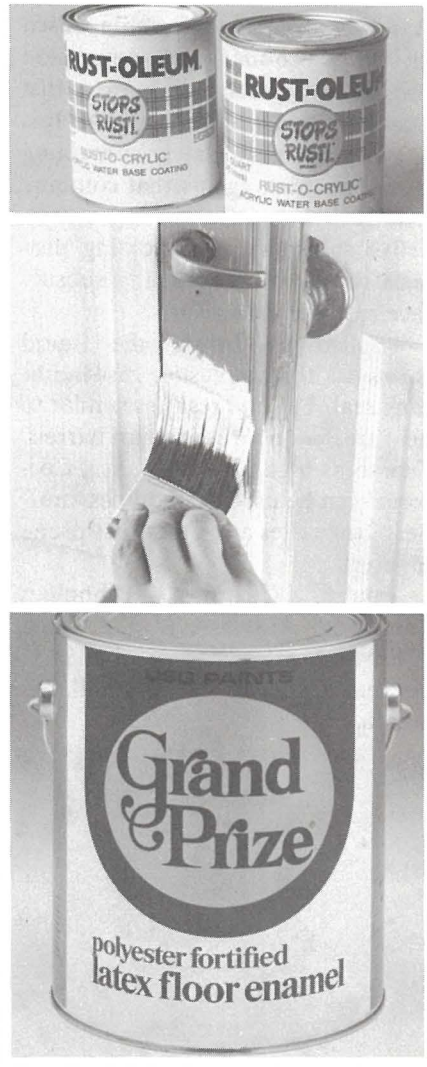


Pocket-sized gauge slips over a zig-zag ruler to spare you splinters.

TWO NEW PAINTS

We tried the new Rust-O-Crylic coating on an old aluminum screen door and liked using the stuff. It dries fast and cleanup is with soap and water. The paint is an effective rust inhibitor and can be used on problem surfaces like masonry and galvanized steel. The paint is available in 10 colors from the Rustoleum Corp., 11 Hawthorn Parkway, Vernon Hills, IL 60061.

Grand Prize latex floor enamel can be scrubbed and is quick-drying—two desirable features in a floor paint. It's from United States Gypsum Co., 101 South Wacker Dr., Chicago, IL 60606



New Rust-O-Crylic paint (top) is $2.50 per half pint or $6.30 per quart. USG's latex floor enamel (bottom) is priced at $17.65 per gallon.

NEW RUST PRIMER

Corroseal, a rust inhibitor and primer, comes in 8-oz. and 1-gal. sizes.

A newly developed formula based on the rust-to-magnetite conversion principle, Corroseal is both a rust treatment and base-coat primer. It is a synthetic resin latex containing rust-converting agents that combine with rust to transform it into a nonactive substance. The coating protects metals from recurring subsurface rust and new rust.

Applied by brush, the liquid forms a thermoplastic rust-inhibiting seal. The end result is similar to heat-treated, nonrusting gun barrels. Due to its high heat resistance, Corroseal can be used on tailpipes, mufflers, barbecues and other rust-prone objects.

Applied Coatings Technology Inc., 1735 Austin Ave., Los Altos, CA 94022, prices Corroseal at $6.50 postpaid per 8-oz. size. One-gal. size is $40.

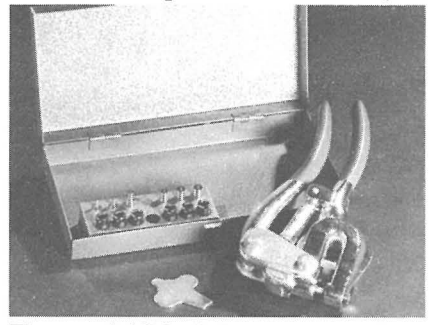
Rusted washing-machine motor housing was revived. The coating is a good primer for all types of topcoats.

CRANK-TYPE FIRE STARTER

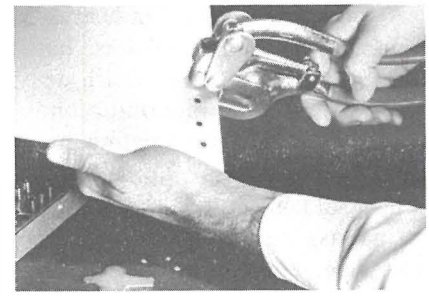
This 20th-century "bellows" delivers a flow of air exactly where it's needed to get fires going in jig time. Besides being useful at the hearth, it's a handy tool for starting barbecue fires—and it eliminates liquid starters, which often leave an "aftertaste." Called Firefly, the tool weighs just 11 ounces. To use it, you simply point Firefly where air is needed and crank the handle. It's $6.95, including postage, from Holiday Camping Products of Alabama, Box A, Brent, AL 35034.

POWERFUL PUNCHER

This hand punch develops a ton of punching power, says its maker. This means you can punch round holes in up to 14-ga. mild steel, as well as plastic, aluminum and the like, using one hand. All of the main parts are drop-forged and heat-treated. The tool comes with a side gauge for depth adjustment; throat depth is 2 in. The Model 8500 kit includes seven punches and dies (3/32, 1/8, 5/32, 3/16, 7/32, 1/4, 9/32 in.) and a case for $29.95.



The punch kit includes seven punches and dies and a metal storage case.



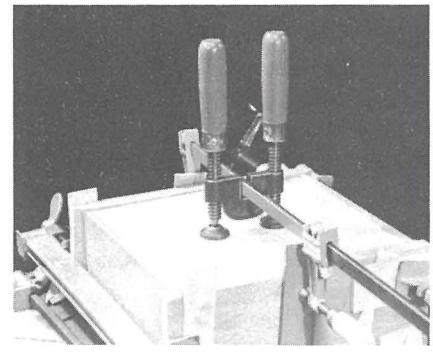
Punch is well balanced and can be used with one hand.

For buying information, write Lustre Line Products, Richmond and Norris Sts., Philadelphia PA 19125.

SPECIAL-PURPOSE CLAMPS

It borders on understatement to say that a workshopper never seems to have enough clamps. Called cross clamps, these new clamps are superhandy for side-gluing operations such as applying a self edge to a countertop.

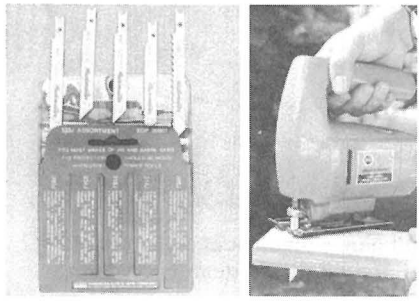
For that job, use the clamp with either a short bar or C-clamp. The Model 99A is $7.80 from Wetzler Clamp Co. Inc., 43-15 11th St., Long Island City, NY 11101.



Here, clamp, held by bar clamp gripping box, holds the drawer bottom.

FAMILY OF SABRE BLADES

Lenox-Hackmaster blade kits for sabre saws not only identify and explain the use for each blade, but also feature top-quality, long-lasting blades. The blades have a heat-treated, steel cutting edge that's reinforced with an electron-beam-welded, spring-steel spine. At hardware outlets, they're $7 for a five-



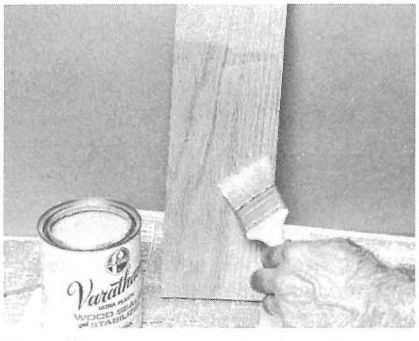
Blade descriptions on pouch help you choose the right blade. A six-tooth blade is used to cut a fence picket.

blade assortment, $4.50 for a three-blade kit. American Saw and Manufacturing Co., Box 504, East Longmeadow, MA 01028.

SUPER SEALER

Flecto now offers a sealer and clear finish made with its exclusive Envirosol system. The Varathane formulation is designed to penetrate

Durability, quick drying and water cleanup are advantages of Varathane Sealer.



The milky appearance is short-lived; it turns clear upon contact.

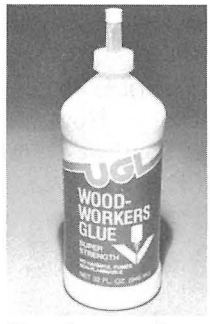
wood fibers and achieve long-lasting stability. The result, the maker claims, is a reduced tendency of wood to expand and contract with atmospheric changes.

The clear finish is available in gloss and satin, and dries up to three times as hard as a conventional varnish. Cleanup is with water. Made by Flecto Co., Oakland, CA 94694.

The top coat has a slight ambering effect, bringing out beauty of wood.

STICK WITH THIS ONE

The maker of Zar wood finishes has recently developed a strong, fast-drying glue that is perfect for all facets of woodworking, including cabinetry, toymaking, crafts and picture-frame making. It sets strong enough for work to be unclamped in

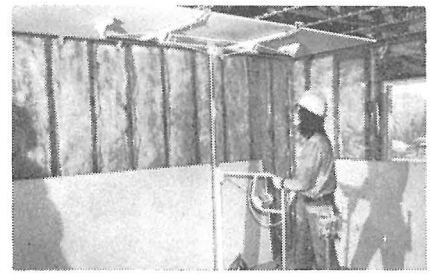


30 minutes; that means clamps can be moved to next project. It reaches maximum strength overnight, and is available at hardware stores and home centers, from United Gilsonite Laboratories, Scranton, PA 18501.

GETTING A LIFT

Available at rental outfits for about $15 per day, this drywall lifter has a 150-lb. capacity and can handle up

This lifter makes it easy to install a drywall panel above waist level.

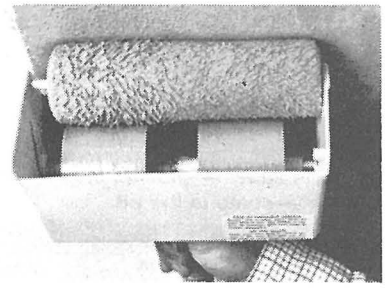


The lifter even lets you boost the drywall panel to the ceiling.

to 4 x 16-ft. sheets. For information regarding availability, write Roland Young, Telpro Inc., Route 1, Box 138, Grand Forks, ND.

NEATER PAINTING

We painted a kitchen with the Roll-O paint applicator, a combination roller-paint tray. The device works like a charm: Plastic rollers pick up paint from the reservoir and transfer it to the roller nap as you roll the tool on the wall. Misting was held to a minimum and the work went quickly, but cleanup takes slightly more time than cleaning a conventional roller and tray. It's $10.70 postpaid and may be obtained from Sherwood Marketing, Dept. RLO-301, 180 Post Rd., East Westport, CT 06880.



Applicator has a built-in reservoir.

NEW DRILLS FROM MILLERS FALLS

The Millers Falls Div. of Ingersoll Rand, 253 East Washington Ave., Washington NJ 07882, has unveiled seven new drills that are labeled, "Super Duty."

The seven models of drills include: three ¼-in. drills with 1900 rpm, 0-1900 variable speed and reversing and 0-4000 rpm variable speed; three ⅜-in. drills with 600-rpm, 1000-rpm and 0-1000-rpm variable speed and reversing; and

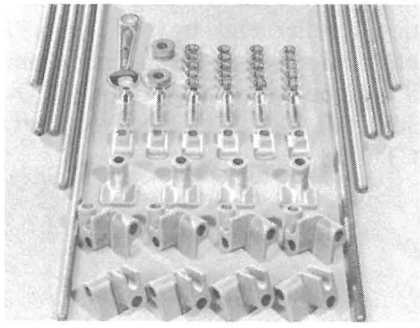
Tough drill comes with 10-ft., heavy-duty cord.

one ½-in. drill with 0-600 rpm variable speed and reversing.

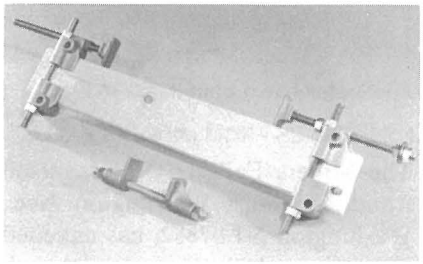
All seven models include all ball bearing/needle bearing construction, heavy-duty chucks, double insulation and a 10-ft. rubber cord. The drills require no grounding.

A DANDY CLAMP KIT

Using threaded rod, aluminum junction blocks and a unique pressure foot, this clamp kit gives workshoppers a way to put together custom clamps and work-holding

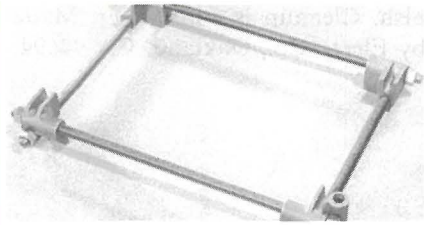


All parts shown—plus an instruction booklet—come in the kit.



Larger of these two bar clamps is made up by using scrap lumber.

jigs, as needed. The kit contains the parts shown and can be expanded with additional rods available at hardware stores. Instruction book comes with the $39.85 setup. The flexibility of the kit lets you create



The four-corner setup simplifies the assembly of a mitered workpiece.

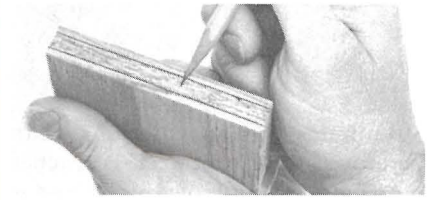
clamps to suit otherwise unsolvable clamping problems.

For more information, contact Jamieson Industries Inc., 2556 Royal Lane 2A-167, Dallas, TX 75229.

NEW TYPE OF PLYWOOD

Georgia-Pacific has announced that a new type of plywood—which will double the number of panels obtained from a tree—will start rolling off a new production line any day now. Called Stable-X, the panels will have oriented-fiber cores of special wood flakes. Its grain will run in opposite direction of veneer face and back.

For availability and prices of Stable-X, write to Cathy Howard, Georgia-Pacific, 900 Southwest 5th Ave., Portland, OR 97204.



Rigid core consists of wood flakes, not the usual laminated veneers.

GOOD GLUE FOR REPAIRS

Boasting a nozzle tip that is nonclogging, Super Wood-Lok has become one of the pet adhesives in my workshop. The industrial-strength adhesive is suitable for many shop tasks, including bonding of leather,

Adhesive's nonrunning consistency makes it good for vertical use.

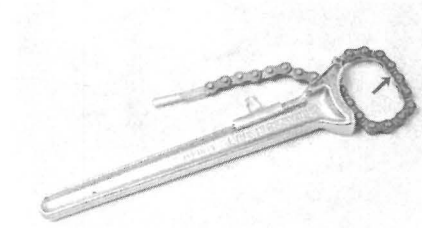
All glue squeeze-out is immediately wiped off. Use a dampened cloth.

high-pressure laminates and paper, in addition to general woodwork chores. A 2½-oz. tube is $1.29; Permabond International Corp., 480 South Dean St., Englewood, NJ 07631.

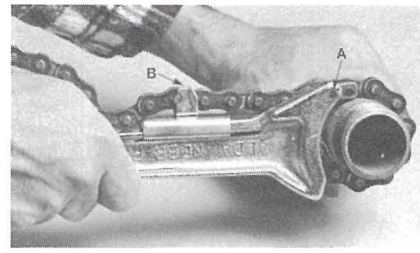
RATCHET CHAIN WRENCH

Though the 360° ratchet chain wrench is truly a tool for the professional, it is also one that many homeowners who do their own piping work might want to know more about.

The ratchet chain wrench will grip



Ratchet chain wrench has serrated teeth on one side of chain (arrow) to grip pipes without crushing them.



To use, wrap chain around pipe, feed end of chain under anchor pin (A), hook to notch on spring-loaded pressure clip (B), and use like any other wrench.

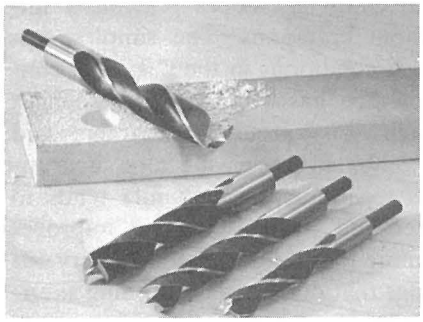
both steel and plastic securely—yet it won't gouge the plastic. Since there are no jaws on this tool, it's great for working in close quarters. The wrench sells for $49 postpaid, and is available from Nicholson Distributing, 1324 Kingston Dr., Ogden, UT 84403.

BIG-HOLE WOODBITS

Many serious woodworkers prefer a bit with a center spur because greater drilling accuracy is assured. Now Leichtung Inc., 4944 Commerce Parkway, Cleveland, OH 44128, is offering four large-diameter versions. We've used all four—⅝, ¾, ⅞ and 1 in.—and they've earned a permanent place in our drill-accessory box.

The bits are priced at $10.95, $12.50, and $13.95 and $15.50 respectively, or $39.95 for all four, plus $1.75 postage.

They're good for use in either drill press or portable drill with ⅜-in. chuck capacity.



Big hole bits feature step-down shanks. For use in ⅜-in. drills.

TWIST TIES AT YOUR FINGERTIPS

Here's a handy product for both workshop and kitchen—a refillable, wall-mounted container that dispenses nonrusting, refillable ties for plastic bags and the like. In the shop, it comes in handy for holding nails, screws and small tools. You can even use ties to hold small parts when gluing. Or try one (mounted in the pantry) for tying food-storage and garbage bags.

To install refill, cover is removed and reel is inserted.

Dispenser is $2.29, refills $1.59, at general merchandise stores such as K-Mart. Weld Tron, 1532 South Washington Ave. Piscataway, NJ 08854, makes it.

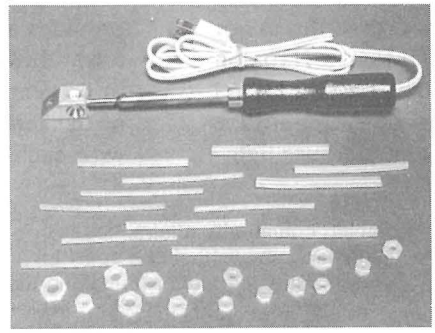
A NEW WAY TO FASTEN

Contrary to its name, the Rad Fastener Kit has no fasteners—it contains an assortment of thermoplastic rods and nut blanks. When you want a special fastener, you can shape one in seconds.

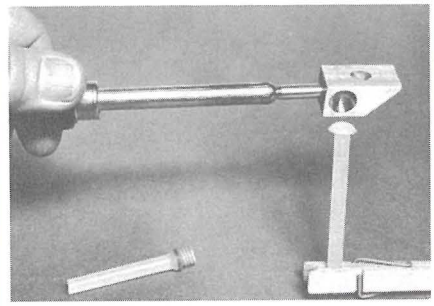
A significant property of the thermoplastic material is that it expands (inside diameter decreases) and shrinks in length when heated. If you have a screw but lack a matching nut, all you do is slip a nut blank over the threaded metal screw or bolt. Then you heat the nut blank until it expands and forms threads.

You reverse the procedure to make a screw when only the metal nut is available. Insert a rod blank into the nut and heat the rod. To form a screwhead, press a screwdriver into the heated plastic.

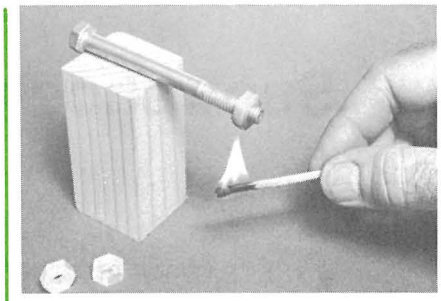
To make a rivet, apply a heated piece of metal to the end of a rod



The kit contains an assortment of thermoplastic rods and nut blanks. The heating iron is optional.



Use the heating tool to form rivet and screwheads. Fasteners of this tough plastic have good holding power.



Heat from a match quickly expands the thermoplastic material so that it takes impression of bolt threads.

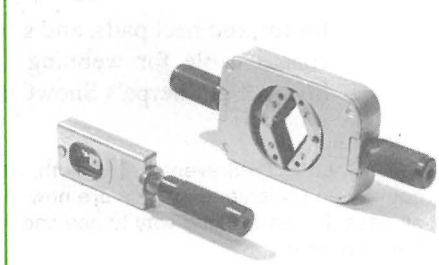
and shape the head. Form the second head after you have inserted the rivet into the parts to be joined.

You can apply heat using the open flame of a match, a soldering iron, a heat gun or the special heating iron that is available from the kit makers.

The kit containing rods and nut blanks is priced at $4.95 postpaid. The deluxe kit, which includes the heating iron, is $14.95 postpaid, from Gama Scientific, Box 351, Chalmers Blvd., Amawalk, NY 10501.

TWO DANDY THREAD RESTORERS

Claimed to be the only tool that can be applied to the bottom thread,



Two top-quality items are Model 6103 (left) and the larger Model 62040.

working outward from the end, the Buckingham Thread Restorer works better than a die-nut because it can also be worked from either end. Tool has the standard set of die blades and handles SAE, USS, NPT or metric type in any pitch from 6 to 28 threads per inch, right- or left-hand threads. Model 6103 is $24, larger-capacity 62040, $67. Buckingham Mfg. Co., Box 1690, 1-11 Travis Ave., Binghamton, NY 13903.

Snowshoeing—old sport, new action

By RAY GILL

■ INSTEAD OF PUTTING it out of business, the booming sports of downhill skiing, cross-country skiing, winter off-roading and snowmobiling have transfused amazing new life into that ancient North Country device—the snowshoe. The speedier sports were supposed to leave snowshoeing far behind, but it turns out that they all can break down far afield where only a snowshoer can come to the rescue. And these web-footed tennis rackets will still carry an ardent outdoorsman to remote spots that can be reached no other way.

Suddenly, even the looks, shapes and abilities of these classics are changing. Refinements in traction make possible climbs over breakable crust that were not attempted before. Better designs, mass production and durability mean products that more people can afford and enjoy. Wintertime races, hikes and climbs are creating a whole new sport.

Gold-anodized aircraft aluminum tubing and I-beam, aerospace, aluminum alloys are showinig up as frames. Vermont Tubbs, one of the major manufacturers, also employs DuPont's Hypalon for toe and heel pads, and stretch-resistant Hytrel coated cable for webbing for its Alum-a-Shoe line. All of Sherpa's SnowClaw models use light-weight tubular aluminum frames, vinyl-covered nylon decking, neoprene lacing and stainless-steel rods and claws in their bear-paw ovals. All-plastic models, some with screw-in metal studs, are made by Trappe Woodstream and others. They are less expensive and are considered good standby shoes for a car trunk or snowmobile in case of a sudden emergency.

Improved traction, however, is one of the true recent breakthroughs, a new ability that allows snowshoers to climb icy slopes previously impassable without crampons. The simplest approach for slick conditions in the past with conventional snowshoe has been to wind a length of quarter-inch rope around the frame and through the webbing. Use plastic rope, if possible, with this technique since manila tends to soak up water and freeze. The real improvement—even more than frames that don't dry out or warp, lacings that don't attract teething squirrels—is better footing grip.

The patented design of the SnowClaw binding provides a cleat at the leading edge of the boot toe and two more framing the sides of the instep to prevent lateral motion, hinged under the ball of the foot so the front snowshoe tip lifts easily with each step. To prevent snow from freezing,

RACES, LIKE THIS event near Duluth, are becoming community affairs. Cross-country and orienteering tests are new activities making snowshoeing a sport for all ages. It's an exciting way to see snowscapes without using fuel or damaging the fragile ecology.

KIT-BUILT Sherpa Snowclaw Featherweights tested successfully on ice crust and deep drifts of Colorado Rockies.

balling and building up on the metal, a loose plastic panel covers the reinforcing between the claws and flexes to prevent ice accumulation. The SnowClaws are also available separately from Sherpa dealers for installation on other makes. Early Winters, Vermont Tubbs and others offer bolt- or tie-on traction bars and crampons.

Sherpa, Northern Lights from Early Winters, and Vermont Tubbs all offer build-it-yourself kits. Tubbs uses conventional ash-frames and neoprene lacing. Traditional wood snowshoes in their eight-model line can be obtained with neoprene or rawhide lacing.

Purist Carl Heilman II of Brant Lake, NY, makes classic custom snowshoes to order. First he starts by selecting a white ash tree which has been growing in moist earth and has a small diamond bark pattern following in a straight line up the tree. Elongated bark patterns are rejected, and the trunk must be large enough to supply four lengths when split in quarters, long enough to allow some trimming when bent.

These pieces, called bows, are trimmed to size before steaming. The bark surface becomes the outside edge of the snowshoe, and is inserted in a forming jig after steaming, when it is most pliable. After drying for a couple of weeks, the bow is removed, scraped and sanded smooth. Crossbars are made and mortised into the frame, which is now balanced so it is slightly tail-heavy at a spot midway between the two crossbars. Holes are drilled for the lacing and notches cut between the holes on the frame exterior, so the lacings will fit snugly with less chance of abrasion.

After final sanding, a craftsman, following Carl Heilman's technique, dismantles frames and braces and brush-varnishes them, using polyurethane varnish plus pipe cleaners to coat the inside of each hole. Heilman's racing Bearpaw, Adirondack, Maine, Cross Country, Green Mountain, Alaskan and Ojibway models range from about $65 up to $115 for the largest with neoprene lacing, more for rawhide.

Learning how to snowshoe is easy, but learning *where* can require additional skill. Trails in snow over thin ice, overhang drift ledges and below avalanche paths require experience to recognize and handle. When mountaineering, it is well to travel in groups of no less than four; in case of injury, one can stay with the victim while two head back for help. *Snowshoeing*, a book by Gene Prater and published by The Mountaineers, Seattle, WA, gives a good introduction to the sport.

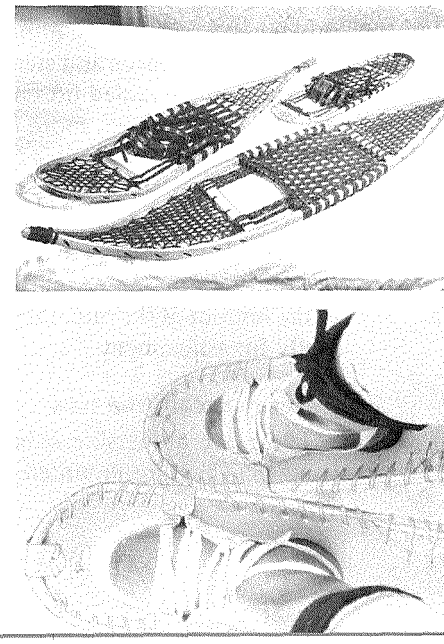
Choose oval-shaped Bearpaws or narrower Modified Bearpaws for mountaineering and brush hiking. Beavertails and larger Yukons have the conventional rudder-action tail. Use long Ojibways, Crees in deep powder snow.

Two organizations help coordinate activities. The U.S. Snowshoe Assn. (USSA) is contacted through George Bosworth, Box 170, R.D. 1, Corinth, NY 12811. Canada's Union Americaine de Raquetteurs Executive Secretary in the United States is Albert Cote, 138 Bartlett St., Lewiston, ME 04240.

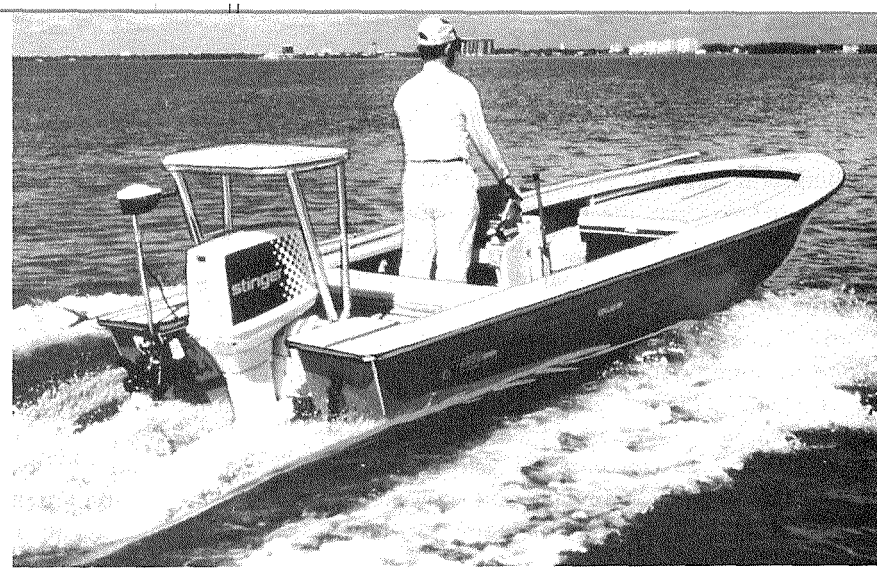
SKIS AND SNOWSHOES are used by rescue teams. Bill Lockey of Tacoma, Washington and team wear Sherpa Lightfoots.

TEXAS SPORTSMAN John McKeel tests Yukon-size Sherpa Mushers with SnowClaws on an icefall. Not advised!

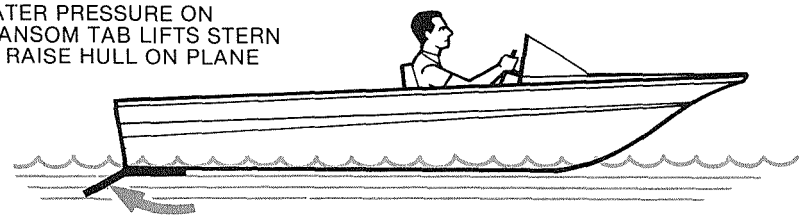
MEDIUM-SIZE cross-country beavertail, small racing bearpaw and long Cree-style Ojibway are examples of Heilman's work. Sherpa Snowclaw Featherweights (bottom); bindings are laced on wearing mittens.



Tabs can trim gas use in half!



By BOB STEARNS



TRIM TABS—sometimes called afterplanes, shims, transom wedges or stern planing boards—have been around almost as long as power boats. However, until prices soared at the fuel dock, they were used only to correct hulls that did not perform properly. Today, though, if properly designed and installed, they can smooth out the ride while saving a remarkable amount of fuel. Here are five trimming systems, listed in order of effectiveness, that should save you many bonus dollars at the marina gas pumps.

transom shims

These are the most basic form of trim control, and the least expensive, but they are also the most time-consuming to install. A pair of these wedges, secured at the extreme aft end of the boat, with one on each side under the transom (or transom bait wells, if the boat has them), can provide extra lift. Since almost all planing hulls, especially outboards and sterndrives, are heaviest in this area, the added lift tends to bring the bow down for a smoother, more level ride.

The primary disadvantage of this system is that a lot of time is consumed in experimenting with different sizes and shapes of these wedges before the best compromise is reached. And because it is necessary for these wedges to be glued or screwed to the bottom of the hull, they cannot be removed easily for adjustment.

preset (manual) trim tabs

These are adjustable shims, but with an advantage: They are mounted on the transom and extend aft, increasing the effective length of the hull without adding more weight. While offering more lift at the transom, they also increase the planing surface in the area where the load is heaviest and often raise the cruising speed. Obviously, more speed from the same throttle setting means more miles per gallon.

These tabs are available in a wide variety of sizes, shapes and materials. Some are stainless steel, others are aluminum, and a few are space-age plastics. Some are "automatic adjusting"—they are spring-loaded, so that at slow speed the pressure of a spring forces the tabs down for more lift. As speed increases, water pressure hinges them up so that they don't tilt the bow down excessively.

engine power trim

Available for almost all outboards over 40 hp, as well as many sterndrive models, this adjustable, propeller-angle trim can give extensive control over hull attitude in the water. The skipper actually aims the angle of thrust, and he can do it while underway at any speed. Not only do you push the bow down to stop the pounding when heading directly into a nasty chop, but you can also raise the bow higher than normally possible at medium to slow speeds, making it possible to keep "your nose in the air" when running before a steep following sea.

Better still, the helmsman can, by the momentary touch of a button, adjust the craft's running attitude to the optimum for that particular speed and sea condition. Obviously, the power-trim

system can also be combined with shims or preset tabs to increase control combinations considerably. Fuel savings possible with a tab-and-power-trim system can run as high as 30 percent, we've found in our test.

power trim tabs

Power tabs can do everything preset trim tabs will do—plus a lot more. One of their many advantages is the way they can be controlled while underway at any speed. You can also raise one and lower the other individually, and the boat's running attitude responds immediately.

Because the skipper, using simple dash-mounted control levers or buttons, has such precise control over the attitude of his craft, the danger of over-control is almost eliminated. This allows installation of much larger tabs than would be safe or practical with preset trim tabs. The largest power tabs that will fit your boat, in fact, should be used.

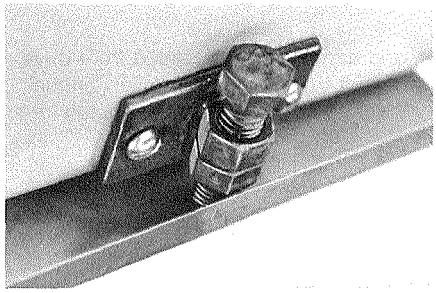
power trim and power tabs

Combine both systems and you get a result that outperforms either method alone. Now you have a precise fore-and-aft control, plus side-to-side trimming which only the tabs can provide. You can now use the trim tabs primarily to offset a crosswind that otherwise would be drenching you with spray. Meanwhile, your engine's power trim can angle your hull up or down for a smoother ride.

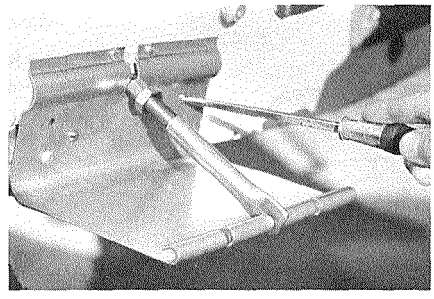
You cannot raise your bow with trim tabs. By raising the tabs, however, as far as they would go (slightly above the horizontal), and trimming the engine to the full outward extent of its power trim range, I found that my boat could attain a much higher bow attitude. That would allow running in up to a six-foot following sea.

safety benefits are a bonus

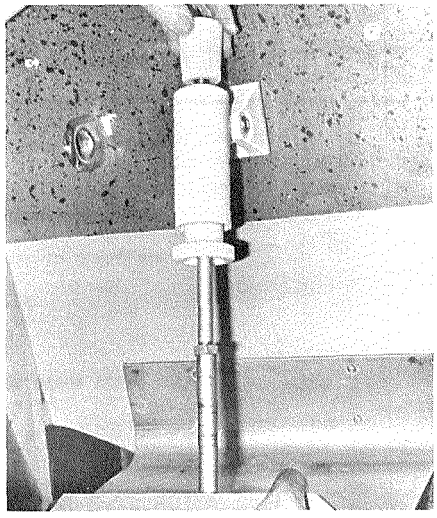
Safety improvement is also a trim tab bonus you should not overlook. Getting home ahead of a storm through choppy and gas-consuming headseas can be a worrisome problem. Reducing the punishment of a pounding ride, plus the chance of a broach, make tabs even more worthwhile.



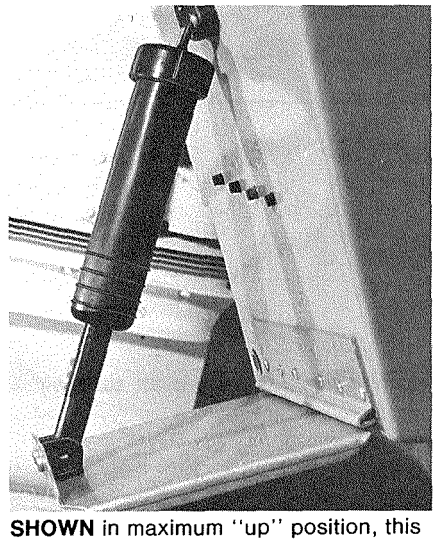
ADJUSTABLE homemade tab is controlled by a bolt threaded through brazed nut.



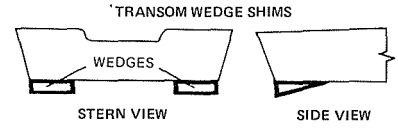
BOAT must be stopped for manual or tool changes in trim-tab angle.



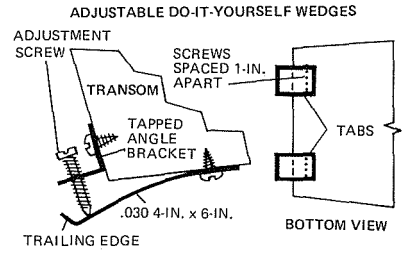
"AUTOMATIC" tab is spring-loaded, extending down at slow speeds.



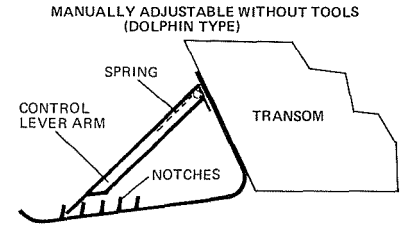
SHOWN in maximum "up" position, this tab is remotely controlled from the helm.



FIXED wedges require trial-error fit.



STAINLESS-STEEL tabs are bent up at rear edge for stiffness, could be cut 5x8 inches, or 6x10 for larger boats.



ARM is lifted or pushed to adjust.

There's a hitch to towing with compacts

Now even front-wheel-drive minis can be put to work pulling small trailers

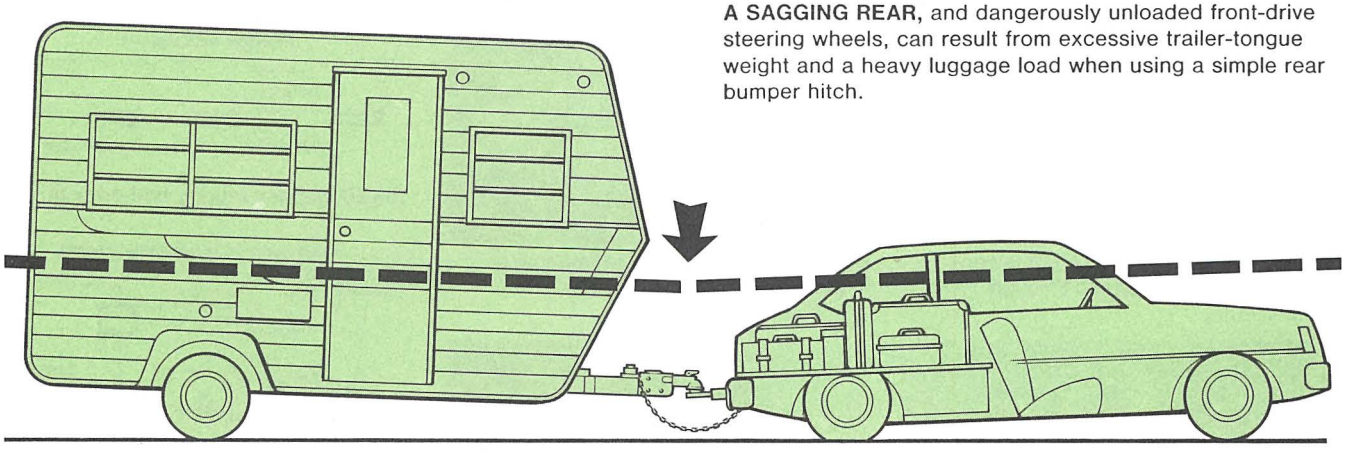
By JOE GILL

■ SO YOU TOW a boat or cargo box, a travel or fold-down camping trailer behind your car. Now you're thinking of replacing your big rig with a compact to save on gas, or you already have made the move. Does that mean you have to give up trailer towing and the runs to campgrounds and launching ramps by family car?

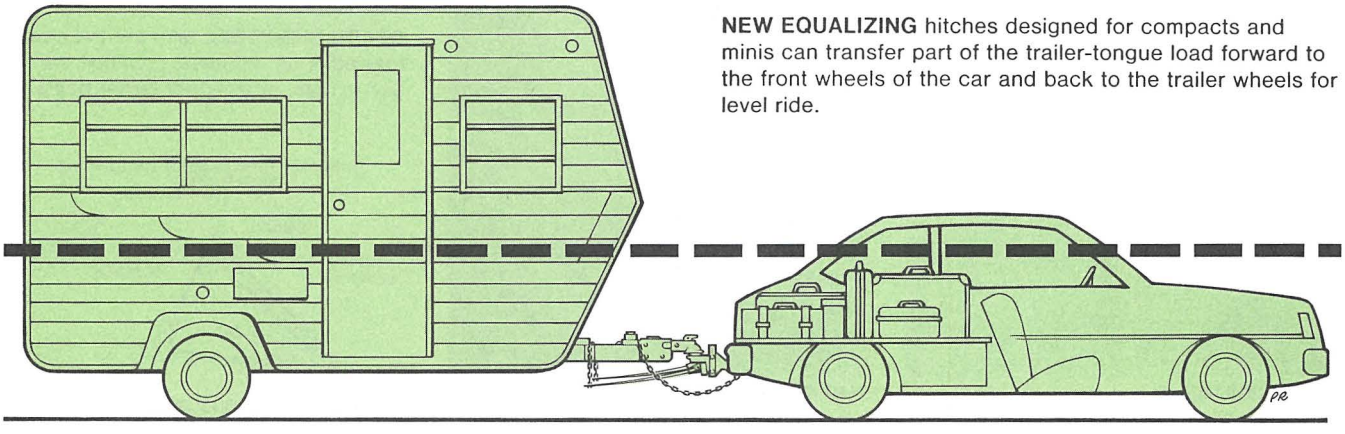
Not if you are careful, and fit out with some new hitch gear. Of course, if you own a heavy, 25-foot boat, or a 35-foot trailer, you may have already been overloading your fullsize family station wagon, despite its heavy-duty springs, oil and transmission coolers and tow package. For a fifth-wheel trailer, cabin cruiser or park-model rig that you constantly haul over mountain passes, a pickup truck as tow vehicle is still the answer.

For lighter loads, however, over shorter distances and modest slopes, your compact can do the job. First, check your warranty; it may specify the maximum tongue load and gross trailer weight that your small car is designed to handle. Your car dealer may not be a trailering expert, but he should be able to get you one of the excellent trailering guides that several automotive companies put out.

When the trailer tongue is lifted and dropped on the ball mount, a percentage of the trailer weight pushes down on the rear of your car, particularly a small one. This load is referred to as



A SAGGING REAR, and dangerously unloaded front-drive steering wheels, can result from excessive trailer-tongue weight and a heavy luggage load when using a simple rear bumper hitch.



NEW EQUALIZING hitches designed for compacts and minis can transfer part of the trailer-tongue load forward to the front wheels of the car and back to the trailer wheels for level ride.

the tongue weight and it may range up to 200 pounds for a 1000-pound trailer, to 350 pounds for a 4000-pounder. These figures are approximations; your final guide should be your car manufacturer's recommendation.

If the tongue weight is 200 pounds, road motion and weight shift when stopping may add 50 percent, or 100 pounds more, to the total weight on the car's rear axle. These 300 total pounds can weigh down the back of your car so that it sags several inches. When the rear of your car drops, the front will "unweigh" and rise an inch or more. This means you will have reduced towing power because of less traction and poorer steering control. With so many small cars coming on the market now with front-wheel drive, the problem is magnified.

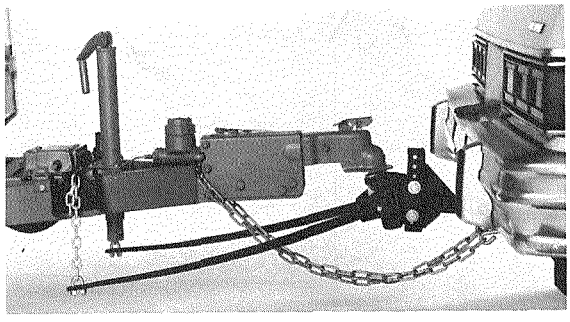
small-car solutions

Though it's true that large cars can haul larger loads, compact owners don't have to give up on the sport. Many manufacturers provide heavy-duty shocks and springs for their small cars. Other heavy-duty options are available. Car manufacturers willing to discuss trailering with their small-model buyers specify Class I (trailers up to 2000 pounds) hitches with a tongue load of not more than 200 pounds.

Trailer equipment manufacturers are less conservative. They recommend first determining gross trailer weight (GTW) on a truck scale; tongue weight can be measured with a bathroom scale or by a system well described in *Travel & Camper Trailer Safety,* a useful free booklet from NHTSA, 400 Seventh St. S.W., Washington, D.C. 20590.

Thirty years ago, as larger and heavier trailers began to aggravate towing problems like bottoming out of the rear springs, reduced steering control and trailer sway, the weight-distributing hitch was developed. Using clever engineering and leverage, some of the undesirable weight on the rear wheels of the towing vehicle is transferred to the front wheels, while additional load is shifted back to the trailer wheels. Properly set up, the tow car and trailer can both ride level.

LEVERS UNDER the ball of the Reese Mini Hitch swivel with road conditions and trailer tracking, but distribute trailer and trunk luggage weight for safer, level ride.



equalizing the load

Weight-distributing hitches have recently been designed and introduced for compact and minicars, and experienced trailer equipment dealers now claim that some small cars can haul loads up to 4000 pounds with an equalizing hitch installed. As with larger vehicles, a tow bar is bolted or welded to the car frame. Its platform has an open box-beam hitch box, into which the trailer's hitch bar with ball mount is locked with a hitch pin.

A spring-bar assembly fits into sockets on the ball mount. These are two tapered and tempered-steel arms that extend back for chain and clamp attachment to the trailer. They can swivel and turn with road conditions, and exert the leveling force that distributes the trailer weight.

sway prevention

The other major difficulty encountered while towing with any size car is trailer sway. This can be caused by faulty tire inflation, trailer design, excessive towing speed or high winds, and can get bad enough to cause a driver to lose control.

There are several devices that help minimize sway. Simplest and least expensive is a friction sway-control fitting attached to the hitch. More advanced methods include the Dual Cam Sway Control from Reese Products, Elkhart, IN. The device is claimed to prevent sway before it starts, instead of reducing it after it has begun. Valley Tow-Rite of Lodi, CA, also has a sway control system. New from Reese, a Mini Hitch equalizing model is especially designed for "downsized" vehicles and is reported to handle up to 4000 pounds of gross trailer weight.

Other equalizing and standard weight-carrying hitches include models from Draw-Tite, Eaz-Lift and Equal-I-Zer, and all are better and safer than a simple hitch-ball clamped on your bumper. For any tow car—and especially a compact or mini—your best guide is to talk to several experienced trailer owners and equipment dealers. Often it's best to then have the dealer make the hitch installation for you. Later, if you trade in, you can usually switch your equalizing hitch to your new car. Now even compacts and minis can become safe, level-riding tow cars for sway-free trailers.

Best knots for the new fishing lines

Many record fish have been lost because a knot failed at a crucial moment. Here are four combinations fit to be tied for a tight, no-slip grip on the latest synthetics

By HOMER CIRCLE

HERE ARE FOUR hot knots selected especially for the tough new fishing lines now being introduced. Improved plastics are making the latest lines tougher, longer wearing and more abrasion resistant, but some knots can slip and come untied or reduce rated test strength by cutting through as they tighten.

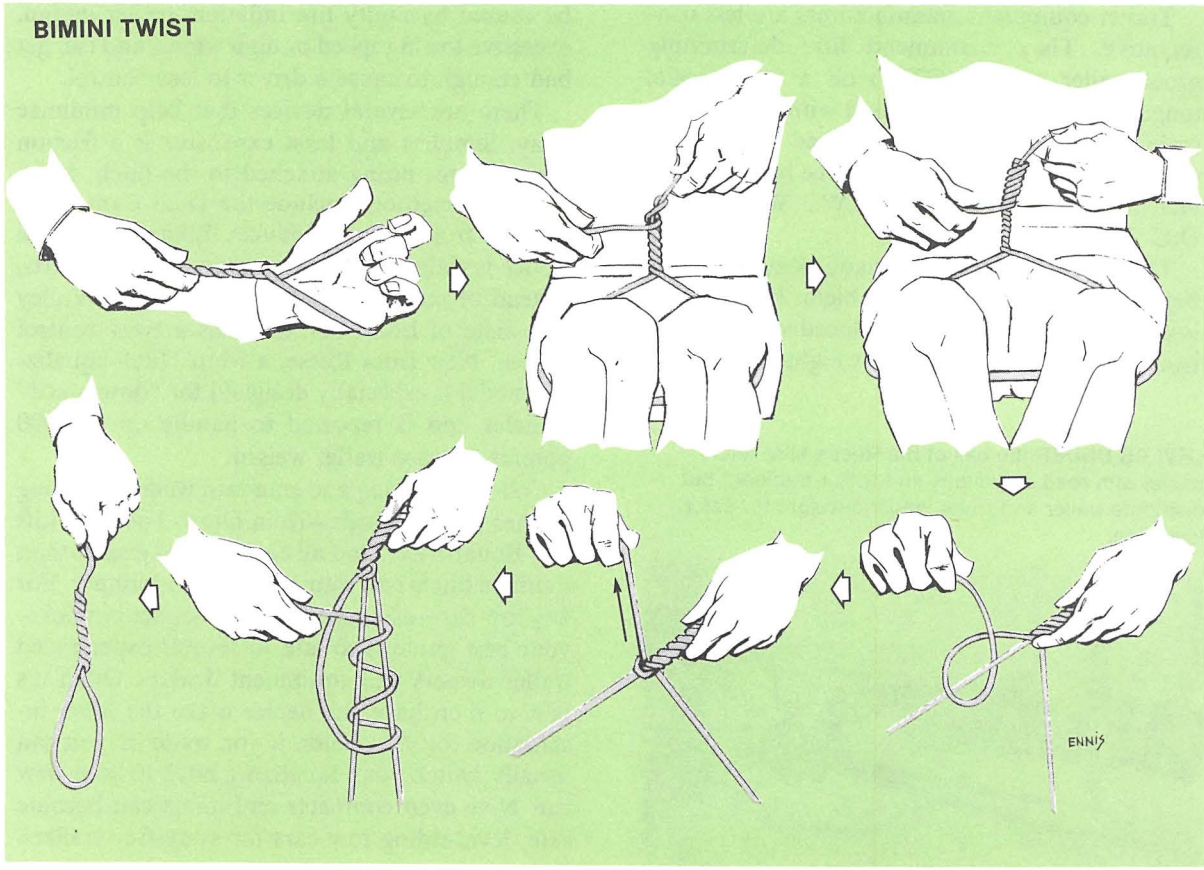
Bimini twist

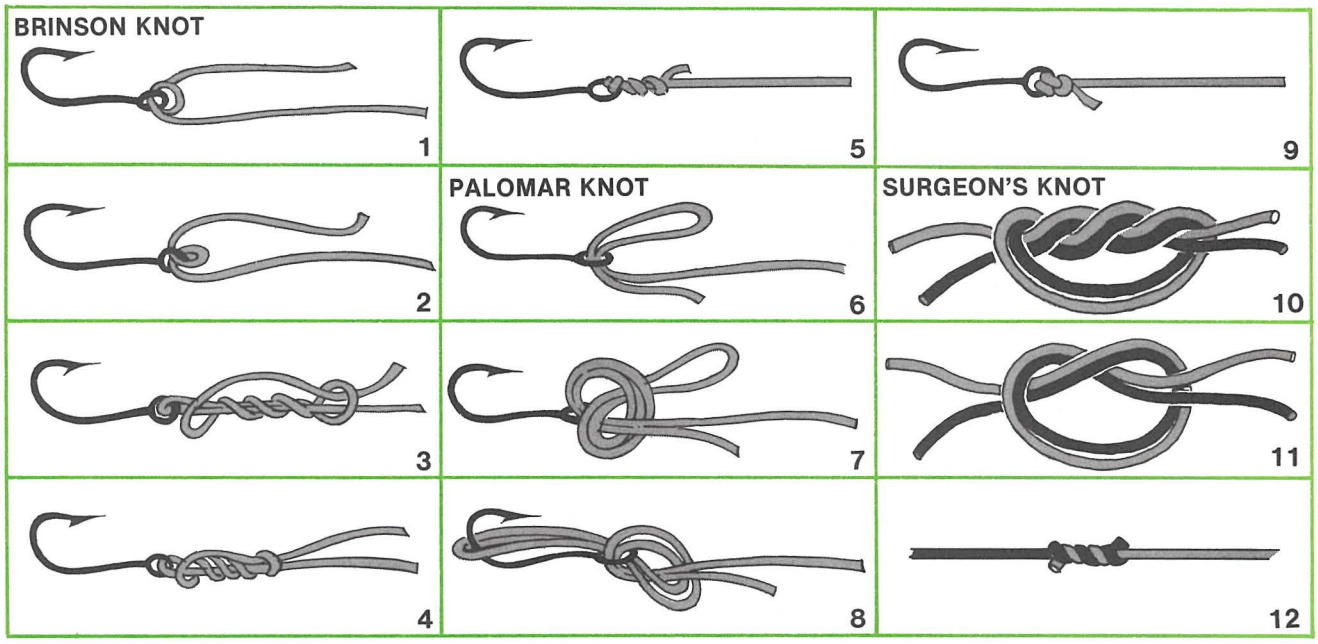
The Bimini twist is my choice when you are fishing the newly popular ultralight tackle and using light lines which might break. It enables you to double the strength of the terminal end of your line. The knot originated in saltwater, is official for record catches, and tests 100 percent of your line's pound-test.

Double the end of the line to form about a 2-foot loop. Place loop over one hand and rotate it 20 times to put twists in line.

Holding in the twists, place your knees together and put the loop in the line over them. Hold tension on the main line as you pull back and down on the tag end, letting it drop over the twists.

Spread your knees apart, increasing tension, and pull slightly downward on the tag end as you increase knee pressure. As you ease tension on





the tag end, it will wrap down over the twists entirely.

Place your index finger in the "V" of the loop and throw a half hitch over one side of the loop. Pull half hitch up tightly. The twists are now secure so you can relax pressure.

Make a three-wrap hitch around both lines and pull up snugly. Clip off the tag end right against the knot.

Brinson knot

This knot was impressed upon me by another knothead, Billy Brinson, a fishing guide at Santee Cooper, S.C. It broke all my other pet knots, so I've been using it since. It tests to 95 percent plus of line strength.

First, insert the line through the eye of the hook; do it again to make a double loop. Lap a loop with the tag end against the standing line, holding it with thumb and forefinger. Make five wraps with the tag end and then run it through the loop.

Let the tag end hang free while you pull the hook and standing line in opposite directions. Loops should fold over themselves to form a neat, tapered knot against the eye of the hook.

Palomar knot

This knot, designed by a Californian named Chet Palomar, is so simple anyone should be able to tie it once he has seen it demonstrated. It checks out above 96 percent and should be used for tying line to a hook, swivel or snap. It is not quite as handy as the Brinson knot when tying to the eye of larger lures, since the loop must slide over the entire rig.

Double the end of your line about a foot and insert the loop through the eye of the hook.

Tie a simple overhand knot in the double line. Slide the loop over the end of the hook or lure. Pull hook and line in opposite directions to snug the knot. Clip off the tag end.

surgeon's knot

When you need to join two lines, or tie a leader to your line, this knot is as functional as it is simple, and can handle lines of different diameters. It makes a small knot that will not bump going through your guides and thus lasts much longer.

Lap the two lines for about a foot and tie a simple overhand knot in the doubled lines. Pull it up until it forms a small loop.

Hold the loop open and tie a second overhand knot, as illustrated (above). Grip the double lines at each end of the loop and tighten slowly.

Snug the knot tightly. Then release the tag ends and tighten further by pulling on standing ends. Clip tag ends against knot. It won't slip.

When tying with a doubled line, keep the lines parallel and don't let them twist. As you make the final draw down, make certain the coils pull up in a neat spiral. Pulled up too quickly, they can overlap and cut each other.

MUCH MORE than rubber dinghies and liferafts, the new inflatables can handle big motors.

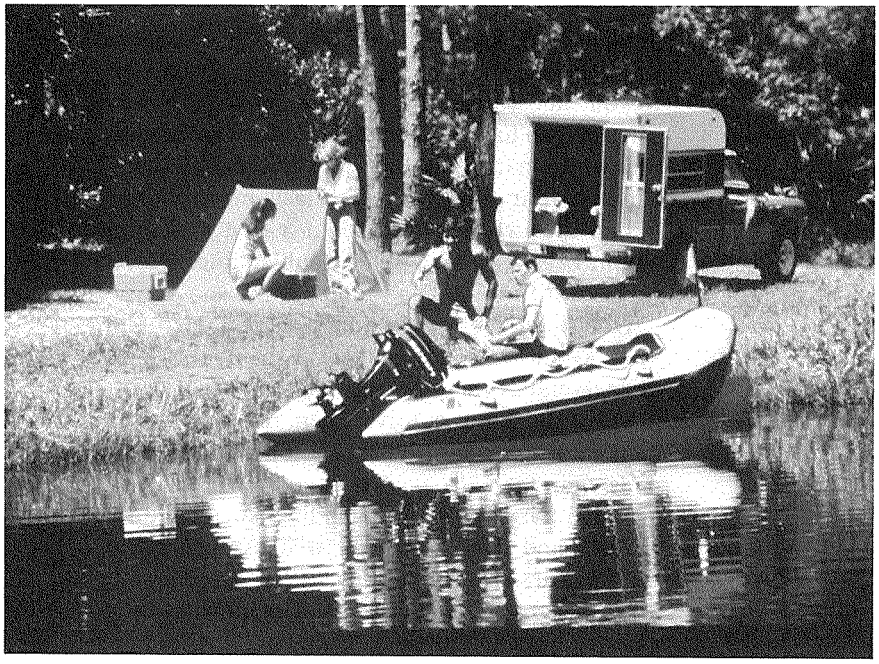
New puff-up boats are tough

By BILL MCKEOWN

PUFF-UP BOATS have been around a long time, but recently many small-craft buyers have been taking a second look.

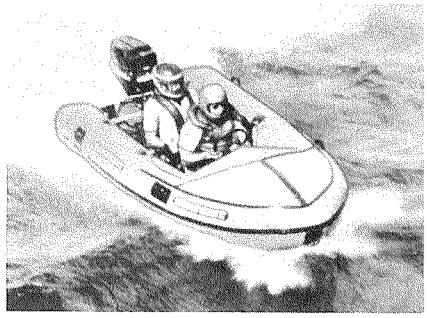
What they've found are second-generation craft that have jumped ahead in performance, durability and cost. One look at the $1000-up

EVEN IN A MINI-CAMPER, there is room to stow a deflated Zodiac and Merc 40 outboard without the need for a cartop carrier or a trailer.



BLOW-UP boats are fitted with forward steering for motors 20 hp and up.

A SEMPERIT made of light Kevlar fiber won the first inflatable race in Miami.



price tags will convince any shopper that these are no longer rubber and plastic toys to play with in a pool. Some of today's models use light, space-age materials to make them more rugged and portable, V-bottom designs for a more comfortable ride, and construction that can handle bigger outboards than ever before. A new Inflatable Boat Assn. now lists 18 companies that make or import them.

Tough fabrics that can resist scraping against barnacles and rocks helped popularize the craft as shore-patrol and surf-rescue boats, and as dinghies that could bang up alongside a yacht without scarring the topside. Newest models may incorporate graphite fibers or DuPont's Kevlar aramid (similar to those used in bullet-proof vests) to add great strength while sometimes decreasing weight. Neoprene, Hypalon or PVC coatings over nylon fabric are also popular to provide puncture and abrasion resistance. Electronic seam sealing and new adhesives have also made it possible to seal in transoms that can mount outboards up to 120 hp.

The well-made inflatable is almost impossible to sink, which is why it makes such a good liferaft. However, it can be capsized—although the latest survival rafts have been redesigned and provided with underwater ballast to maintain upright flotation in big seas. Dinghies, runabouts and kayaks that inflate can blow over when a gust of wind gets under the bow, and pound passengers as the flat bottoms slap over choppy seas. Now, many makes incorporate a semi-deep-V shape with an inflated or fixed keel to help ease the ride.

Blowups are beginning to be classified into four grown-up groups.

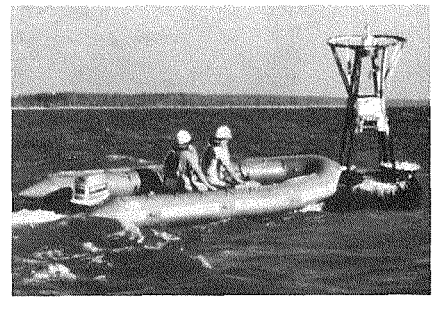
- Dinghies, oval doughnut in shape, usually rowed or paddled.
- Fixed-transom models that can mount an outboard motor: divided into small runabouts under 12 feet, 12- to 15-footers and craft over 15.
- River boats and whitewater rafts.
- Last is a catch-all category that includes inflatable canoes, catamarans and kayaks.

The new synthetics that give the extra strength, lightness and durability to inflated boats also help prolong their life while deflated. Backyard or boatyard storage is not necessary for inflatables, of course. Even the smallest apartment usually can accommodate one, and a backpack or compact car can get most models to the water. Once a modern blowup comes out of the closet, the creases smooth out more easily and fatigue and cracks are less likely to show up in the fabric. Maintenance usually means washing salt and sand off the boat and letting it dry in the shade before storage. New pumps powered by a car battery speed up reinflation so that cartopping or trailering usually isn't necessary.

BEACHING is easiest with new, lighter, abrasion-resistant inflatables. Oval-shaped Sevylor Caravelle adds a bracket for a 2-hp outboard.

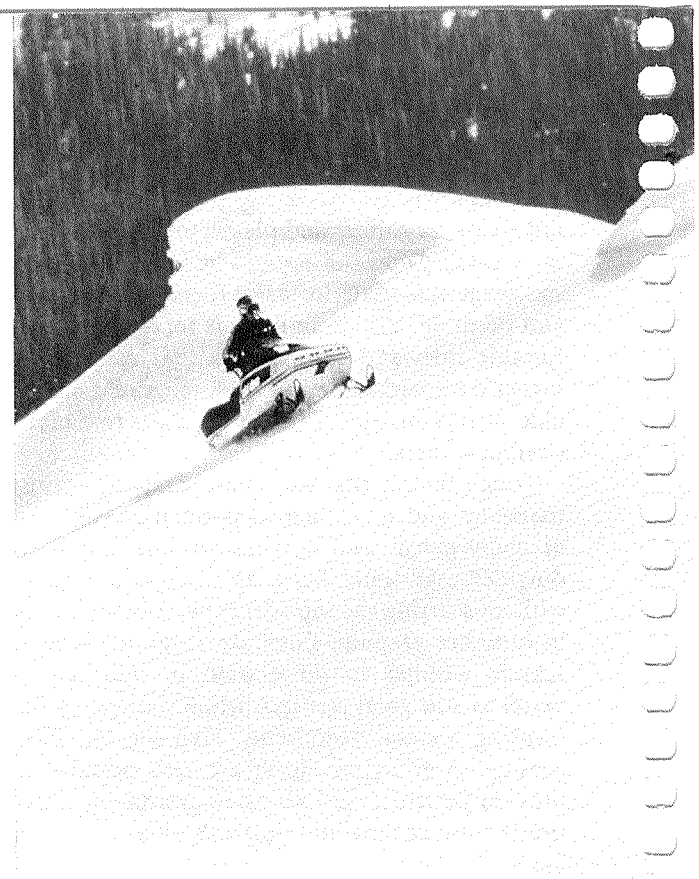
WITH an Eska astern and an electric forward, Sevylor's XK330 is a bass boat.

AS A WORKBOAT, a big 17-foot Avon can handle up to 120 hp.



The latest gear for snow sports

By BILL MCKEOWN



MOUNTAIN CLIMBING by snowmobile, is a good test for the new outdoor garments.

SKATES, SLEDS, skis, camping, hunting, fishing and hiking essentials—they're all being improved to make outdoor activities better when winter arrives. Plastics that take the cold without turning brittle, rust-resistant metals, thermal-barrier insulations, breathable waterproof fabrics are incorporated in new designs for old-fashioned snowdrift sport.

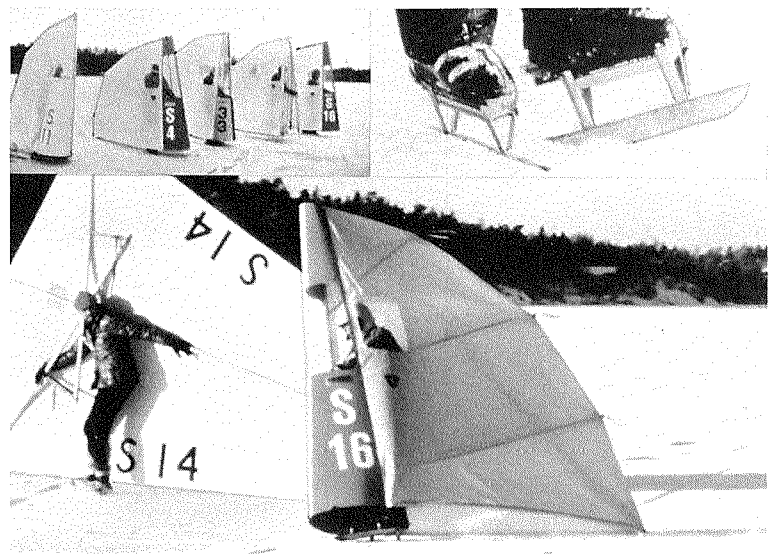
Many cross-country skis now have fish-scale designs molded into the center kick area for better uphill traction, without the use of waxes or climbing skins. Even skateboard skis have been announced. Lightweight plastic bindings are available.

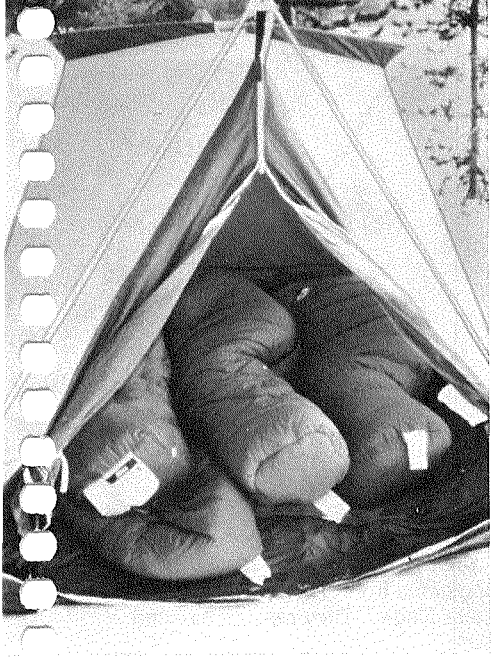
Ski clothes are becoming more streamlined and backpack parkas are graduating from the quilted, down look with the use of 3M's new high-heat-retention, low-bulk Thinsulate. For garments, tents and sleeping bags that need to keep rain out and yet let sweat evaporate, Gore-Tex fabrics have proven successful. Foul-weather gear that can overlap seasons is included in the Red Ball system with a waterproof Go Parka that is PolarGuard-lined, plus Calhoun insulated Bush Boots, or Lightfoot thermal boots. Catalytic heaters are still the safest way to get heat inside a tent, and camp stoves are being improved to make bitter-weather starting easier.

Winter mountain climbers have such refinements as avalanche radio signalers and sectional probes for survivors, a flexible pack frame by Peak 1 and a pack board that converts to a cargo sled from Mountain-Man Industries, 616 North Rouse, Bozeman, MT 59715. Called the Pack-N-Sled, it weighs about 7½ pounds and comes in Standard, Mountaineering and Child's Snow Stroller models. Accessories include a safety harness and roll bar, so a youngster can be carried papoose-style or in the sled. Hip-belt towing harness and poles let you tow cargo while on skis or snowshoes, and even a dog harness is offered.

Recreation vehicles, once water lines have

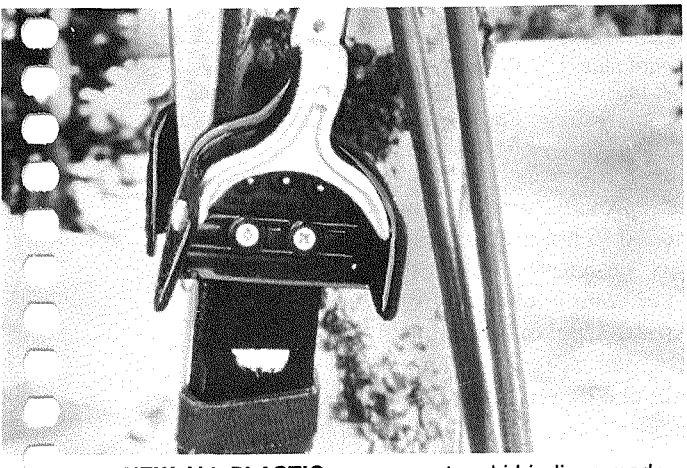
COLEMAN'S one-burner model and Charmglowette LP barbecue, below left, make quick meals. As shown below right, the Ice-Wing from Sweden surrounds the skater for races with other Ice- Wingers or conventional sail-skaters.





PEAK 1 TENT is an externally supported A-frame type with a roof spreader bar and new shock-corded ribs. Inside are Holubar and Peak 1 sleeping bags.

CROSS-COUNTRY boots with ankle support, camp boots and booties keep feet warm. The skier at left wears Trak Rallye Nowax fish-scale skis and a flex-frame Peak 1 pack.

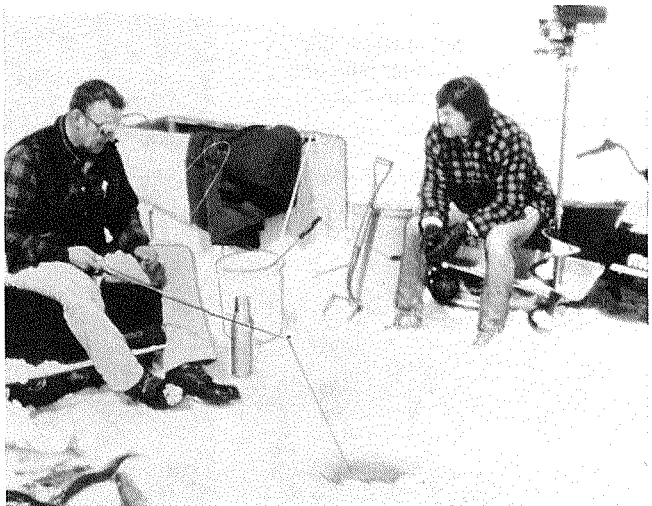


NEW ALL-PLASTIC cross-country ski bindings made of Celcon, by Pinso Sport, are claimed to collect much less ice and snow while in use.

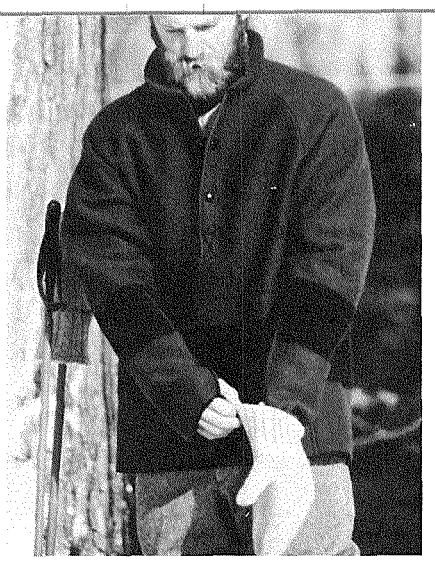
THE LATEST cross-country skis, including models with built-in no-wax climbing treads, can be fingertip measured for proper fit, as shown here.

OFF-SEASON sport includes camping in a winterized Winnebago, and snowmos on a TracPac trailer.

EVEN ICE FISHING is more pleasant with the proper gear. Shown here are insulated clothes and a 1-hp, 2-cycle ice auger for drilling holes.

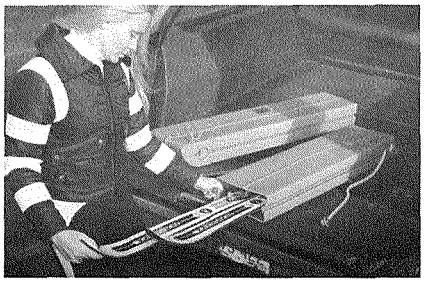


A BACKPACK that turns into a youngster's sled with rollbar, or a cargo sleigh for a hiker, skier or man's best friend, the Pack-N-Sled is a winter sport and camping aid.

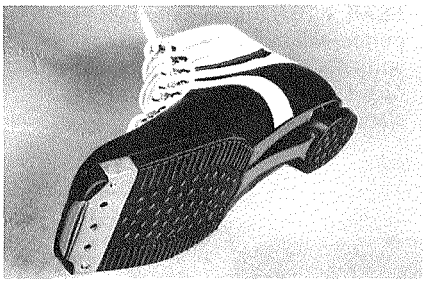


ONE REMEDY for cold wrists between gloves and sleeves, Woolrich Blanket Thumb Shirt has thumb hole to hold sleeve down.

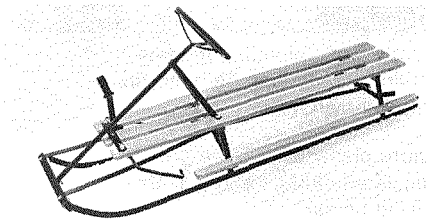
SPECIALIZED safety aid, plastic ski racing gates from RapidGate, Aspen, CO, are hinged. They replace bamboo spears.



EXTENDING to protect eight-foot skis, or telescoping to less than half that size, Ski-Pack case from K-Mac is $50.



FOR REPAIRING cross-country ski boots, or making your own, stainless $5.75 rebuilding clips are by Ryder, Salem, OR.



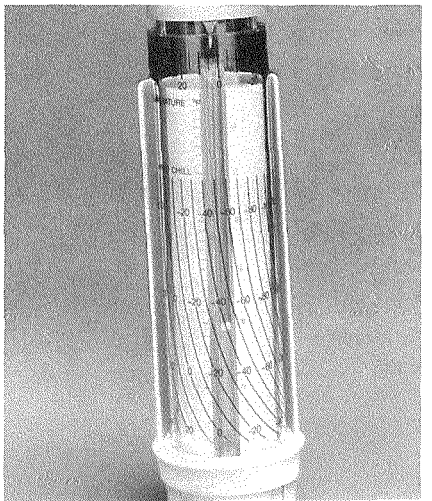
A COMBINATION of sled, skis and scooter, imported folding Norwegian Kiks (top), and Commander mini-bob with wheel are from Cardon Enterprises, Arlington, WI.

WINTERIZED, Jimmy 23-foot mini motorhomes from Consolidated Leisure have hot-water showers and tubs.

been well insulated, provide winter camping. Antifreeze can be added to holding tanks.

Another ingenious design is the Ice-Wing, available in plan, kit or completed form from the inventor, Anders Ansar, Upplandsgatan 19B, S 113 60 Stockholm, Sweden. Speeds to 50 mph are claimed. Plans are about $20, kits $300 and completed Ice-Wings $800. Skate blades that can mount on ski boots and lift a skate sailor above snow-covered ice are also available.

HOW COLD is cold? Taylor Instrument's Wind Chill Meter gives temperature, wind speed, chill factor.



LIGHTWEIGHT aluminum avalanche probes that join to make up various lengths are from Mountain Safety Research, Seattle.

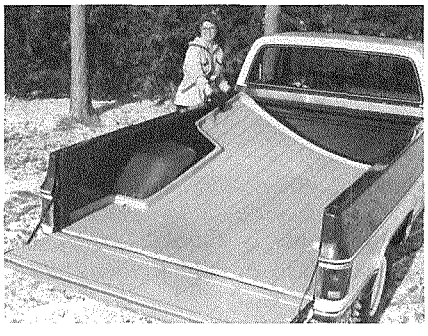
Unusual accessories for campers

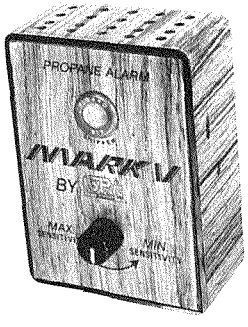
FOR A YEAR when many campers will be adding accessories to save fuel and make outdoor vacations fun with shorter trips, many improved gadgets are appearing.

Backpackers and tenters can choose clothing and fabrics that are waterproof and yet "breathe," letting the sweat of a hike evaporate. Compact cooking and sleeping equipment that will stow in a compact-car trunk is on the market—expensive, but available. Recreational vehicle owners and renters can add new heaters or airconditioners.

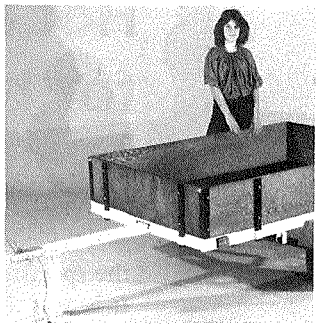
A GEODESIC DOME of a tent, the new freestanding Earth Station from Early Winters is 10 pounds, $500.

A PICKUP bed guard (left) from L&R Distributing, POB 337, Wood River, NE 68883, comes in sizes to fit standard and compact imported trucks. The Mark V alarm (right) senses dangerous levels of propane, butane, methane or natural gas. It's about $42 from Lopat Industries, 1558 E. So. Anaheim Blvd., Anaheim, CA 92805.



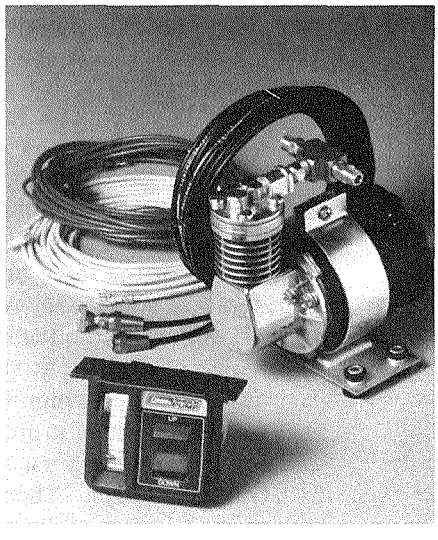


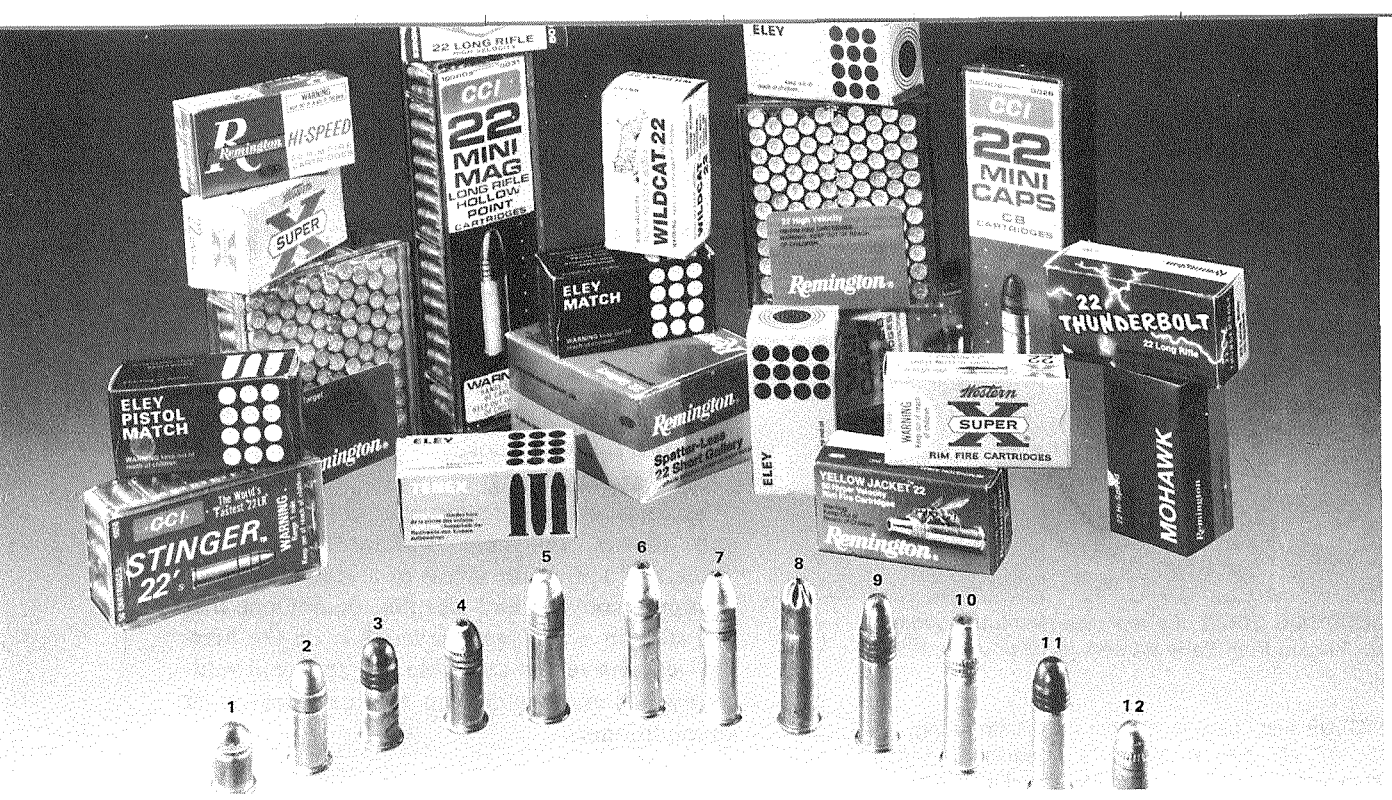
UNFOLDED from a narrow two-foot width, the Fold'N Fun trailer can open to a 4 x 8-foot platform for cargo, a pair of motorcycles or snowmobiles, or a camping tent or boat. Innovative Products, POB 2723, Appleton, WI 54913.



SOLAR HEAT is reported to warm the water in a new unfoldable $75 Solar Shower from L&R Distributing, POB 337, Wood River, NE 68883. A reservoir holds six gallons of sun-warmed water. The package opens into a cabana for dressing.

FOR ADJUSTABLE shock absorbers, Coleman's new Shock Pump works with a dash switch and gauge. It has a 24-foot hose.





POPULAR .22 cartridges are: (1) CB Cap; (2) Remington Short; (3) CCI Mini Cap CB; (4) Winchester Western Super-X Hollowpoint; (5) Eley Tenex Match; (6) CCI Stinger; (7) CCI Hollowpoint; (8) Remington Shot Load; (9) Winchester Western Long Rifle Wildcat; (10) Remington Yellow Jacket; (11) CCI Long Mini CB; (12) Remington Short High Speed.

Hot new .22s for better shooting

By ANGUS LAIDLAW

THE MOST POPULAR modern cartridge in the sportsman's arsenal has to be the .22 rimfire. It is also the oldest cartridge available—and the newest.

Biggest news in .22 ammo has to be the hypervelocity loads now available. At almost any shooting range or gunshop, there are shooters who swear by any of the three available brands. They have good cause: Most .22 rifles and handguns have distinct ammo preferences. What works wonders in one gun throws fliers from every target group in another example of the same make. This goes for the older shorts, longs and long-rifle cartridges as well.

Assuming a gun is in good shape, clean, and has showed itself capable of accuracy with groups of an inch or less at 25 yards, the chances are that one of the three brands of hot-velocity cartridges will suit it. One of the three may also not work well at all. So the best move is to buy a box or two of each right at the start. Then, as hand-loading expert John Wooters puts it, you "ask your rifle" which it prefers.

What do you buy? First on the scene was the CCI-Omark Stinger. Then came Winchester Western's Xpediter, followed by Remington's Yellow Jacket. Going rate is about a penny a round more than standard or high-velocity .22 long-rifle loads.

What do you get? Lighter bullets going faster can mean very nearly .22 magnum performance at much less cost for a special rifle. The advantages are longer effective range on small game up to 150 yards, flatter trajectory for more hits with less holdover, better wind-bucking and more power.

The basic .22 cartridge is an old design. There are many antique and semi-antique arms chambered for it. To prevent accidents from overloads, the Sporting Arms and Ammunition Manufacturers Institute (SAAMI) specifies a maximum pressure to which any standard cartridge can be loaded. This is a worthwhile safety feature, but it has limited the development of higher-velocity cartridges.

Then CCI-Omark engineers came up with an answer. It has a somewhat lighter bullet than the standard 40-grain, long-rifle slug, in a slightly longer case, but with the same outside dimensions so that is would fit standard chambers. And since the fast powders used in .22s burn out in 16 inches or less traveling through barrels of 20

inches or longer, slower burning powders could be the answer. Then bullet velocity is increased by extending the push on the lighter slug rather than by raising the combustion pressure to dangerous levels while pushing the bullet harder.

After a lot of experimenting, CCI-Omark developed the highly successful Stinger. It has a 32-grain, hollowpoint bullet in a case 1/10 inch longer than the standard long-rifle case. Specially developed powder keeps on pushing the bullet all the way out a 20-, 22-, or 24-inch barrel. The result is a 1687-f.p.s. muzzle velocity, compared with 1200 to 1300 for the high-velocity, long-rifle hollowpoint. Energy jumps 42 percent from 142 foot-pounds for the high-speed, long-rifle slug to 202 foot-pounds for the Stinger. The lighter bullet is moving faster and the basic law of physics applies—kinetic energy increases with the square of the velocity.

Shortly before CCI's Stinger, Winchester produced the Dynapoint, a high-velocity, long-rifle cartridge with a tiny dimple in the nose, giving greatly improved effectiveness on varmints. Then Winchester came up with its own hypervelocity .22, the Xpediter. It puts out a 29-grain, Lubaloy-copper-coated hollowpoint at 1680-f.p.s. muzzle velocity and 182-foot-pound muzzle energy.

Now Remington has come along with the Yellow Jacket, with a 33-grain, truncated-cone, hollowpoint bullet at 1500 f.p.s. The slightly heavier, slower bullet has 165 foot-pound of impact energy. Any of these potent pest eliminators cost about 50 cents more a box and give an inch or smaller target groups at 25 yards from guns that like them.

While the new hot cartridges grab the limelight, .22 shorts and long rifles by Winchester, Remington, CCI and Federal are still the biggest sellers. Shorts produce almost the same energy at 25 yards that long rifles do at 100, and are quieter. Gallery loads with frangible bullets that break up into lead dust on impact are even quieter and cheaper. Oldtime BB and CB caps are again available, and are good for informal target shooting with a suitable backstop. In an effort to create .22 shotgunning for back-yard trap and skeet with junior-size clay birds, long-rifle loads with No. 12 birdshot were introduced and, known as snake loads, are still available.

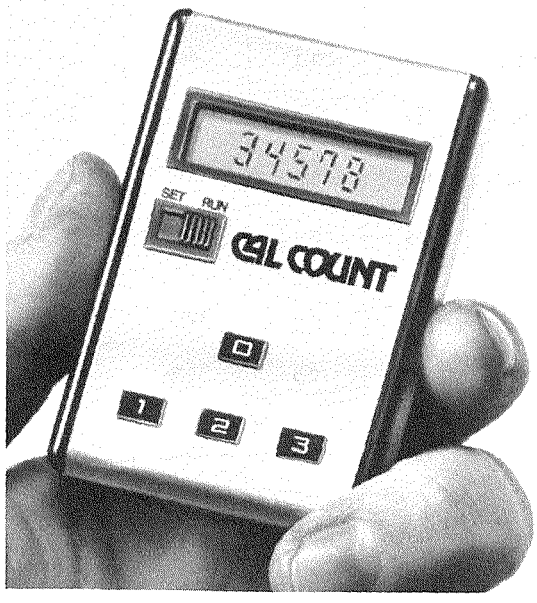
HOW VELOCITY AFFECTS BULLET DROP

Cartridge	Bullet Weight (grains)	Muzzle Velocity (ft./sec.)	Muzzle Energy (ft.-lb.)	Midrange Trajectory (in.)	Velocity at 100 Yards (ft./sec.)	Energy at 100 Yards (ft.-lb.)
.22 Short (Standard Velocity)	29	1045	70	4.8	872	49
.22 Short (High Velocity)	29	1095	77	4.5	903	52
.22 Short (High Velocity, Hollowpoint)	27	1120	75	4.4	904	49
.22 Long (High Velocity)	29	1240	99	3.9	961	59
.22 Long Rifle (Standard Velocity)	40	1150	117	4.0	975	84
.22 Long Rifle (High Velocity)	40	1255	140	3.6	1016	92
.22 Long Rifle (High Velocity, Hollowpoint)	37	1280	135	3.5	1013	84
Winchester Western Dynapoint Super-X	40	1255	140	3.6	1016	92
Winchester Western .22 Xpediter (Hollowpoint)	29	1680	182	2.5	1079	75
Remington Yellow Jacket (Truncated Cone, Hollowpoint)	33	1500	165	2.8	1075	85
CCI-Omark Stinger	32	1687	202	2.2	1158	78
.22 Short CB	29	715	—	—	—	—

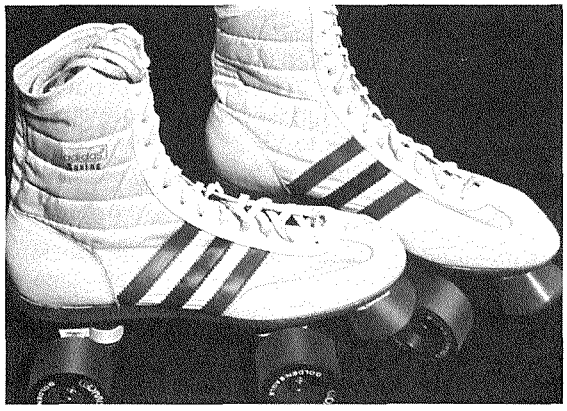
THE CLASSIC LOOK of a cedar-planked canoe is available for home builders in a Canoe-In-A-Box kit, complete with cedar and fiberglass, for $645 from Old Town Canoes.

For sports buffs

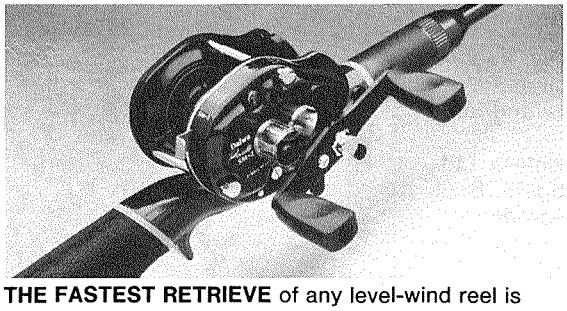
PROGRAMMED for the user's metabolism, $70 Cal-Count totals calories burned by all forms of exercise.



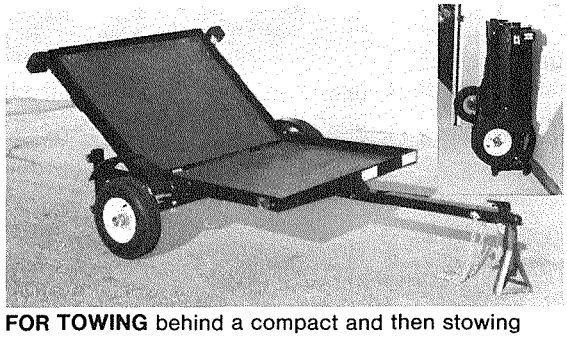
THE $40 BROOKS HUGGER GT is called the first breathable but waterproof running shoe.



OMNISKATES has combined what it calls the lightest high-top shoe, from Adidas, with skate bottoms, $100.

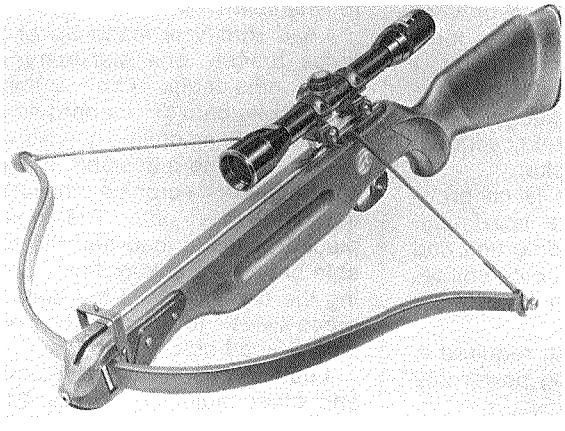


THE FASTEST RETRIEVE of any level-wind reel is Daiwa's claim for their Procaster SM-2A reel ($65). The reel has an impressive 5.2:1 gear ratio.



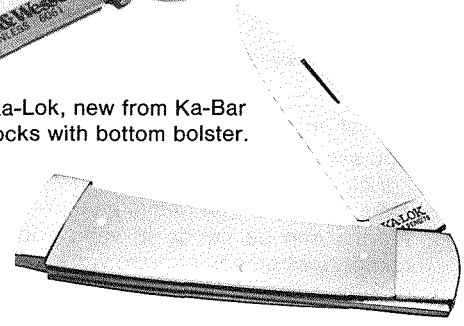
FOR TOWING behind a compact and then stowing folded in a 20-inch space, $460 Tow'N Stow is by Trail-R-Craft.

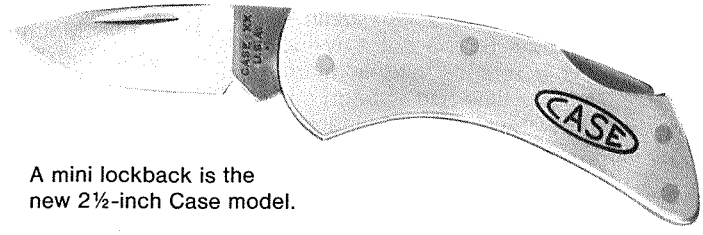
CROSSBOW with a telescopic sight is available as a rifle or pistol from B&P Barnett Ltd. of Lambeth, Ont.



New from Smith & Wesson, Maverick is stainless.

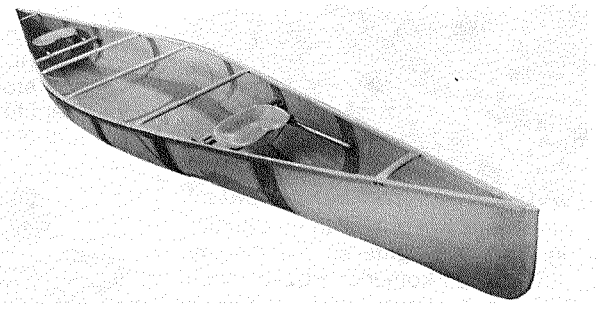
Ka-Lok, new from Ka-Bar locks with bottom bolster.





A mini lockback is the new 2½-inch Case model.

QUALITY KNIVES, many with lockback and stainless steel, are newly popular: $30 Maverick with sheath, $29 Ka-Lok with invisible lock, the $19 Mini Case.



KEVLAR ARAMID fiber and a new vacuum-bag molding process make possible this 18-foot, 35-pound canoe, from Wenonah.

NEW POLE system for the Coleman 6-pound Backpack Classic two-person tent now makes it free-standing without pegs.

Great new products for auto buffs

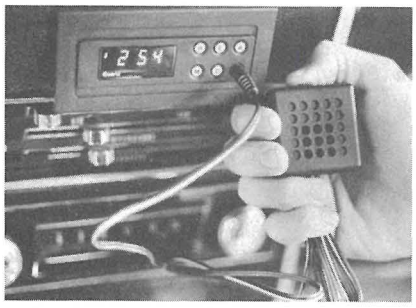
Prices shown on these pages were in effect at the time this article was prepared.

Digital auto alarm clock

You see a number of quartz-crystal car clocks on the aftermarket nowadays, but most don't have an alarm. Alarms can be handy in vans and campers when you need to wake up or remember to take dinner out of the fridge.

Sparkomatic's "Travelin' Time 3" Model SCL-3 not only incorporates a remote, plug-in alarm, but also tells time and date on a lighted digital display. Installation takes about 15 minutes unless you sink the clock in your instrument panel.

You have only three wires to hook up: a hot lead, a ground and a



wire that's hot only with the ignition on. This last lights up the display.

The Sparkomatic SCL-3 costs $40 to $45 at auto stores. It's made in Taiwan, distributed by Sparkomatic Corp., Milford, PA 18337.

Ten years of moonlight

When my car conked out recently on a dark and lonely road, I discovered that my flashlight had also joined the deceased. Next day I solved the dead flashlight battery problem with the purchase of a Moonlight.

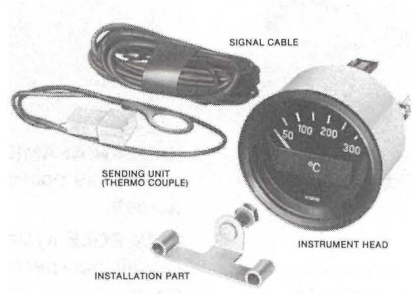
It's powered by a C-size lithium battery that has a 10-year shelf life and provides 12 to 15 hours of steady light. The Moonlight will function at temperatures down to −65° F. The Lexan housing is unbreakable and waterproof, and the switch is recessed into the base of the light so there's no accidental battery drain.

The Moonlight is fully guaranteed. The $17.50 retail price includes the lithium battery and three spare bulbs.

Order from Early Winters Ltd., 110 Prefontaine Place South, Seattle, WA 98104.—*Bob Berger*

For hotheads

My biggest gripe for years has been the lack of standard equipment gauges on most cars. On some, you can't even get them as optional equipment. And idiot lights only tell you the story after a malfunction. If you want to avoid a malfunction, as I do, and cure it before it happens, a



good gauge is the best insurance.

To make up for this lack of foresight by my car's manufacturer, I recently installed a VDO cylinder-head temperature gauge. The gauge comes with wiring, sending unit and mounting bracket.

Installing the gauge is no problem. Just remove one sparkplug, slip it through the sending unit and install the plug. The sending unit remains wedged between the cylinder head and sparkplug.

The only other wiring required is a splice into an existing power line for the gauge bulb.

The VDO temperature gauge is available at most auto parts stores for $46.15. It is not available directly through VDO, but if you need more information, you should write to VDO-Argo, Box 2630, Winchester, VA 22601.—*T.A.*

Erase radio crackle

Does your car radio or stereo crackle and boom every time you turn the volume knob? If so, it no longer means a trip to the sound shop. Radio Shack now sells an aerosol cleaning fluid that rids radios of boom-producing residue. Called Archer TV Tuner & Control Cleaner and Lubricant, it's simple to

use. You take off the radio tuner knob and collar, insert the thin plastic "straw" and squirt. The cleaning fluid doesn't harm plastic or rubber, and it's nonflammable.

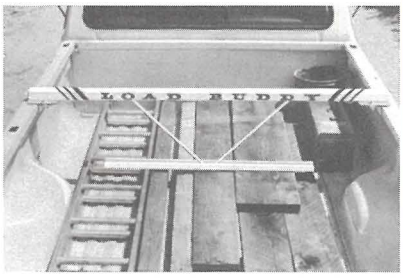
The six-ounce can is $1.19 at all Radio Shack stores.

Pickup buddy

For anyone who carries loose gear in a pickup truck, here's good news from FKM Inc. Called Load Buddy, it secures anything from refrigerators to wheelbarrows.

Load Buddy is made up of two cross braces, one stationary, the other adjustable. The stationary piece bolts onto the inboard side of the bed wall; no drilling or welding is necessary. The adjustable brace is operated from a crank on the side of the stationary one. The unit is placed over the load and the movable brace is cranked down, pressing the cargo against the bed. The brace swivels to secure even irregularly shaped objects.

Load Buddy is at NAPA stores and other outlets for under $120.

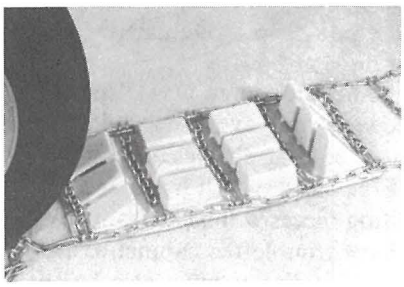


For more information contact FKM Inc., 2699 South Bayshore Dr., Suite 600, Coconut Grove, FL 33133.

Simple chain installer

Installing snow chains used to be a hassle for me until I discovered Sno-Bloc. Sno-bloc is a yellow ramp made of tough polycarbonate plastic. It's 9½ inches wide by 21½ inches long, weighs just 2½ pounds and is divided into four sections. The first section raises the car's wheel 2 inches off the ground. The middle two sections are level. The last section acts as a brake so that you can tell when your tire is correctly positioned on the ramp.

To use Sno-Bloc, the chain is placed with its crosswise links in the ramp's indentations (which are between the four main sections). The car is then driven forward so that the wheel rests squarely on Sno-Bloc's middle sections. The chain can then be fastened easily because the indentations allow it to move slightly.



Each Sno-Bloc is so strong it can support 2000 pounds. Thus, they can be used on any vehicle that weighs less than 8000 pounds. It costs $12.95 postpaid from Sno-Bloc Inc., 17981 G Sky Park Circle, Irvine, CA 92741.—*Moss Miller*

Windshield repair kit

To passersby, Tony Jacino appears to have lost his senses. There he stands, next to his 1968 Buick LeSabre in a Howard Johnson's Restaurant parking lot, calmly making cracks in the car's windshield with a metal ball.

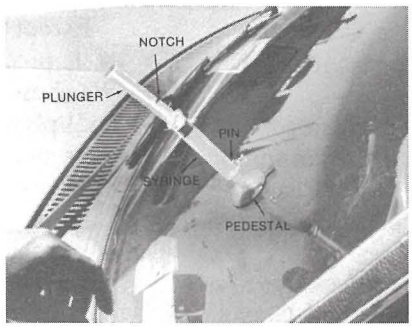
But Tony isn't crazy. He's making the cracks on purpose to demonstrate to me how his new resin repair kit can fix a small "bull's-eye" crack in the Buick's laminated windshield.

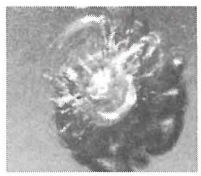
First, he applies a special pedestal to the crack—it has a hole in its center so the resin can get to the glass. The pedestal is mounted on an adhesive base.

He then attaches a large syringe to the pedestal (it comes without the needle). Two premeasured solutions, which come in their own small syringes, are squirted into the large syringe.

A plunger is then placed in the big syringe. A pin is removed so that the plunger can be pressed down very easily.

Next, the pin is replaced and the plunger is drawn up, creating a vac-





uum which draws most of the air out of the solution. After 10 minutes, the plunger is depressed until a notch is engaged that holds it firmly in place. This forces the epoxy solution into the crack under pressure.

After four hours at 50° to 70° F., the entire apparatus is removed and discarded. The repair, while not perfect, is certainly a big improvement. All that remains visible is the tiny point of impact, and glare is greatly reduced.

Unfortunately, the kit cannot repair cracks that have "spread." But Tony informs me he is working on this.

The kit can be ordered from Clear Star Products, Box 737, East Moriches, NY 11940. It's $13.95, plus $2 for postage and handling.—*Moss Miller*

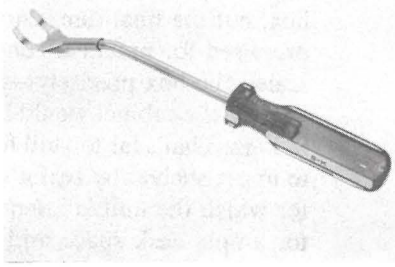
Handy quartz-halogen light

Whenever I turn to my 6-volt, battery-powered lantern to illuminate something at night, it always seems that the batteries have become weak or gone dead. Recently,

though, I tested a compact (3½ x 6¼ x 4-inch) quartz-halogen spotlight made by Ushio Electric of Tokyo.

Dubbed Handy Light, the unit plugs into my car's cigaret-lighter socket, thus assuring a reliable source of power. Its light output is 90,000 candlepower, more than most regular headlights will put out on high beam.

Handy Light has a 12-foot cord and a built-in handle for easy use. It is available for $14.95 postpaid from Ushio America, 140 East Savarona Way, Carson, CA 90746.—*Moss Miller*



Sparkplug lead puller

SK Tools' new sparkplug lead puller has a handle like a screwdriver's and a metal shaft with a special clip at the end. The shaft is bent at an angle. Since there are no handles to squeeze together, as on a conventional plier-type lead puller, the SK puller can remove leads that are in very inaccessible places while preventing painful burned or bruised knuckles.

The SK lead puller is manufactured by Dresser Industries Inc., 3201 North Wolf Rd., Franklin Park, IL 60131. It is available at most auto-parts and hardware stores for $4.49. Ask for SK part No. 73601.

The ultimate desk for the crayon set

What could be a better design for a child's work area than a giant crayon box? This huge version of the famous Birney & Smith box is a fully equipped center. It includes a bulletin board, pegboard, paper roll, crayon holder and loads of storage space

By HARRY WICKS

BY POPULAR DEMAND, the names and logotypes of famous manufacturers are appearing on everything from T-shirts to bumper stickers. And now we introduce our giant crayonbox work center featuring the instantly recognizable Crayola logo—the manufacturer has approved its use by readers on a work center built for their own use.

All kids who have seen this intriguing "box" take to it right away because there is an instant recognition of the logo. The fact that they play "in" the work center will keep the youngsters happy for hours on end.

We designed and proportioned the cabinet as close as possible to the scale of a real Crayola box, but the final dimensions were slightly compromised for practical considerations. If we had scaled the box precisely—while assuming a 4-ft. width—the cabinet would have to be more than 7 ft. high. That's far too tall for safe and easy access to upper shelves by zealous youngsters of the age for which the unit is intended. The width allows for ample desk space and a pair of doors wide enough to provide for a number of functions.

The unit is heavy enough for it to be freestanding. But, if the children who will use the desk tend to be overly gymnastic, you had better secure the cabinet to the wall by installing three or four screws of adequate length through the cabinet back into wall studs.

The deep doors ride on globe casters which take the strain off of the hinges and provide stability, especially when the doors are closed. For the latter reason, the casters are positioned toward the front edge of the doors—instead of at the back where they would be almost out of sight.

The desk flap is supported by two swinging brackets that are positive-holding and safe. The space under the desk stores a combination bench/step stool. By standing on the middle or top step the average child can reach the upper areas easily. The 30-watt fluorescent lamp installed in the cabinet illuminates the cork display board as well as the desk work surface.

Except for the desk surface, which is made of ¾-in. pine, the entire cabinet is built of plywood. We chose Duraply MDO (medium density overlaid) plywood for the prototype—even though it costs more. This is top-quality fir plywood with a resin-overlaid surface which is ideally suited for painting. It saws without splintering and consists of sound inner plies. *Note:* Use MDO plywood which is surfaced both sides (S2S) for cabinetry.

Much of this project involves cutting large plywood pieces with a portable saw. Use a fine-tooth plywood blade and a good straightedge guide. When you cut a 6- or 8-ft. length, drive a few nails into the guide strip—and partly into the workpiece—to prevent bowing.

Start with cabinet cross members. Rip off 1 in. along a long edge so you have a sheet 47 in. wide. Next, cut the top, bottom, shelves and lightshield strip to size. If the 47-in. width is cut accurately, these inside-fitting pieces will be the same length, and you will have troublefree cabinet assembly. Desktop and shelf stiffeners must also be cut to the 47-in. dimension out of the ¾-in. stock.

Cut the back and two side panels to size and mark positions of horizontal members on the insides of these pieces. Using a drill bit, bore pilot holes along centerlines.

For strength at butt joints, preglue ½ x ¾-in. cleats to the sides and back at positions below the shelves and desk panel. (Top and bottom cleats aren't needed.)

Before starting the cabinet assembly, attach shelf stiffeners to the shelves and sand the raw edges. Also, cut the desk flap to size (slightly

OPENED, THE DESK provides all sorts of room for storage and kids' activities.

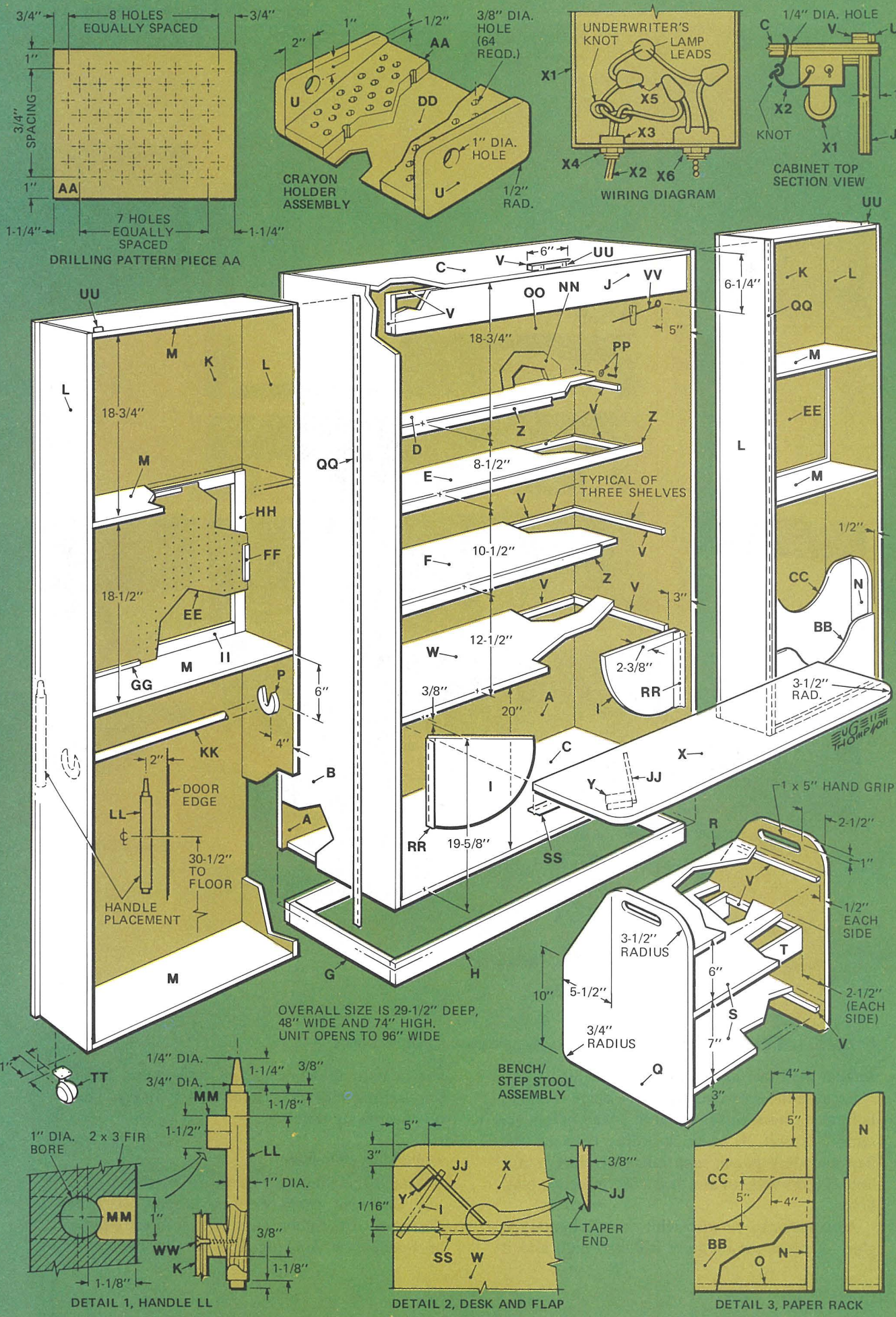
smaller than the main desk panel's width).

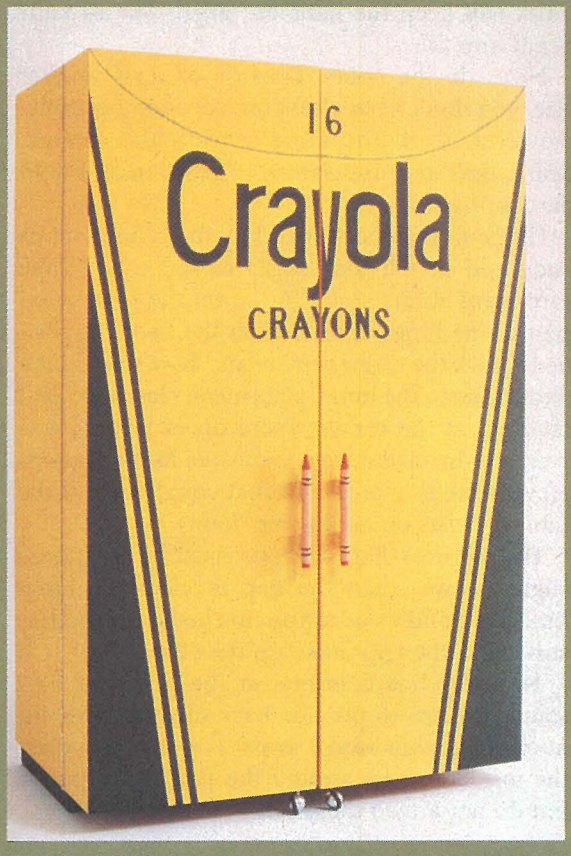
Because the continuous (piano) hinge is on the bottom surfaces, this is easier to install before assembly. Insert 3/32-in.-thick shims between the flap and desk panel; tape hinge in place, mark hole centers with an awl and drill the screw pilot holes.

Assembly can be with white or aliphatic-type glue—if room temperature isn't too high and if you're used to working fast. Otherwise, use a slow-setting hide or animal glue to assure adequate working time.

assembling the cabinet

Attach the shallow base to the bottom panel. Lay one side panel on two lengths of 2 x 4 (shimmed if the floor is uneven) so there will be no bouncing or rocking. Use parallel clamps to


3/4"
8 HOLES EQUALLY SPACED
3/4"
1"
3/4" SPACING
1"
AA
7 HOLES EQUALLY SPACED
1-1/4"
1-1/4"
DRILLING PATTERN PIECE AA
2"
1"
1/2"
AA
3/8" DIA. HOLE (64 REQD.)
U
DD
1" DIA. HOLE
U
1/2" RAD.
CRAYON HOLDER ASSEMBLY
UNDERWRITER'S KNOT
LAMP LEADS
X1
X5
X3
X4
X2
X6
WIRING DIAGRAM
1/4" DIA. HOLE
C
V
UU
1/2"
X2
KNOT
X1
J
CABINET TOP SECTION VIEW
UU
C
V
6"
UU
V
OO
NN
J
VV
5"
18-3/4"
PP
V
Z
D
Z
8-1/2"
E
TYPICAL OF THREE SHELVES
V
V
F
10-1/2"
Z
V
V
3"
W
12-1/2"
2-3/8"
RR
3/8"
20"
A
I
3-1/2" RAD.
6-1/4"
L
K
L
QQ
M
EE
M
1/2"
CC
N
BB
UU
M
K
L
L
18-3/4"
M
QQ
HH
FF
18-1/2"
EE
M
II
GG
P
6"
4"
KK
2"
DOOR EDGE
B
LL
A
30-1/2" TO FLOOR
HANDLE PLACEMENT
M
G
H
I
RR
19-5/8"
SS
C
X
Y
JJ
1 x 5" HAND GRIP
2-1/2"
1"
R
V
1/2" EACH SIDE
3-1/2" RADIUS
T
6"
2-1/2" (EACH SIDE)
10"
5-1/2"
S
7"
3/4" RADIUS
Q
V
3"
BENCH/ STEP STOOL ASSEMBLY
OVERALL SIZE IS 29-1/2" DEEP, 48" WIDE AND 74" HIGH. UNIT OPENS TO 96" WIDE
1"
TT
1/4" DIA.
3/4" DIA.
1-1/4"
3/8"
MM
1-1/8"
1-1/2"
LL
1" DIA.
1" DIA. BORE
2 x 3 FIR
MM
1"
WW
K
3/8"
1-1/8"
1-1/8"
DETAIL 1, HANDLE LL
5"
3"
JJ
X
3/8"
JJ
1/16"
Y
I
TAPER END
SS
W
DETAIL 2, DESK AND FLAP
4"
5"
N
CC
5"
4"
BB
O
N
DETAIL 3, PAPER RACK



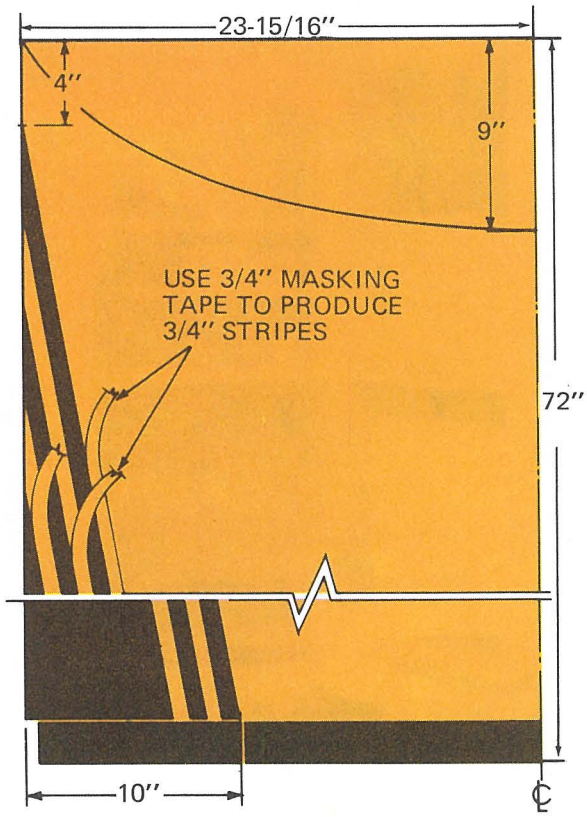
THE FAMOUS Birney & Smith Crayola trademark shows when the doors are closed. The handles are made to look like giant crayons for easy opening.

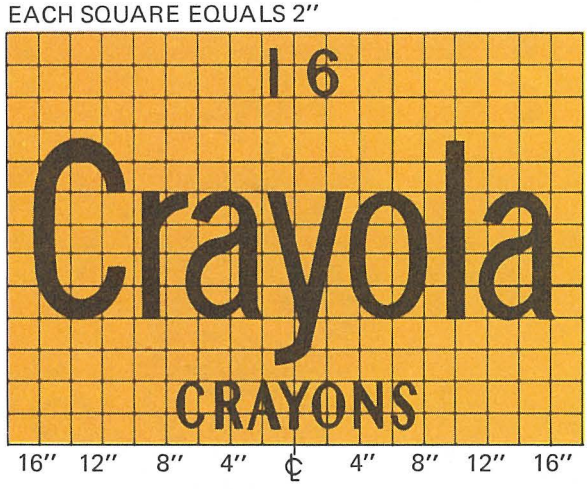
CASTOR-MOUNTED doors on the box make its opening and closing a snap for youngsters. If unit is wall-mounted, castors can be set further back.

MATERIALS LIST—ULTIMATE DESK

Key	No.	Size and description use
A	1	½ × 48 × 72" plywood (back)
B	2	½ × 20 × 72" plywood (sides)
C	2	½ × 20 × 47" plywood (top, bottom)
D	1	½ × 8¼ × 47" plywood (shelf)
E	1	½ × 11¼ × 47" plywood (shelf)
F	1	½ × 15¼ × 47" plywood (shelf)
G	2	½ × 2½ × 19" pine (base sides)
H	2	½ × 2½ × 47" pine (base ends)
I	2	½ × 11 × 12" plywood (flap supports)
J	1	½ × 47⅞ × 47" plywood (light shield)
K	2	½ × 23 15/16 × 72" plywood (door fronts)
L	4	½ × 8½ × 72" plywood (door sides)
M	8	½ × 8½ × 22½" plywood (door tops, bottoms, shelves)
N	2	½ × 3 × 19" plywood (paper rack sides)
O	1	½ × 3 × 21½" plywood (paper rack base)
P	2	½ × 3"-dia. plywood (paper roll rod discs)
Q	2	½ × 14½ × 19" plywood (bench sides)
R	1	½ × 11 × 18" plywood (bench seat)
S	2	½ × 14½ × 18" plywood (bench step, bottom)
T	2	½ × 2½ × 18" pine (bench step stiffeners)
U	2	½ × 3½ × 7" plywood (crayon holder sides)
V	1	½ × ¾" × to fit, pine (cleats)
W	1	¾ × 18½ × 47" plywood (desk)
X	1	¾ × 12 × 46¾" plywood (desk flap)
Y	2	¾ × 1½ × 3" pine (desk flap stops
Z	3	¾ × 1½ × 47" plywood (shelf stiffeners)
AA	1	¾ × 7¼ × 8⅝" (crayon rack)
BB	1	¼ × 13½ × 22½" plywood (paper rack, front)
CC	1	¼ × 19 × 22½" plywood (paper rack, back)
DD	1	⅛ × 6⅝ × 8⅝" plywood (crayon holder backup)
EE	2	⅛ × 18½ × 22½" Peg-Board
FF	4	¼ × ⅜ × 18" pine (trim)
GG	4	¼ × ⅜ × 22½" pine (trim)
HH	4	1 × 2 × 18½" furring (Peg-Board support)
II	4	1 × 2 × 19½" furring (Peg-Board support)
JJ	2	⅜ × ½ × 12" hardwood (flap levelers)
KK	1	¾"-dia. × 22⅜" dowel (paper roll holder)
LL	2	1"-dia. × 11" dowel (handles)
MM	4	1 × 1⅛ × 1½", cut from 2 × 3 fir
NN	1	18½ × 45¾" Homasote
OO		5-mm × 18½ × 46¾" roll cork
PP	4	1" × No. 10 fh screw, countersunk washer
QQ	2	1½ × 72" continuous hinge
RR	2	1½ × 11" continuous hinge
SS	1	1½ × 46¾" continuous hinge
TT	2	Shepherd No. 9019 Noia, 2½" ball caster
UU	2	Amerock T 9700 door catch
VV	2	Screw eyes
WW	1	5' cord
XX	9	Clothes pins
Y1	1	36" single fluorescent lamp fixture
Y2	1	Lamp cord and plug
Y3	1	⅛" hex nut
Y4	1	⅛" cord bushing
Y5	3	Solderless connectors
Y6	1	Pull chain switch

turn the page





hold the shelves and desk panel upright. Add the top and bottom last. Lay the other side in place on the cross members and start a nail into each one.

Lift the side panel, apply glue to both surfaces and nail. Add the top and bottom; then remove the clamps below. With a strong helper, grasp both ends and flip the assembly over, being careful to keep the whole thing intact. Nail and glue the second side.

Lay the unit on the floor, back side up, and glue and nail in the back. The predrilled lead holes will keep the nails on target. Set all nailheads and fill.

Next, do the doors. Because of their smaller size, you don't need cleats for the door assembly. However, work the same as with the cabinet: Mark, drill and use clamps to position and hold parts upright.

Hinge-fit the doors next. Lay the cabinet on its back and attach the hinges to the sides. Tape cardboard shims about 3/32 in. on the edge adjacent to the hinge and position the doors in position. Mark the screw centers and bore pilot holes. (Note: due to the hinge placement, clearance isn't required at the center where doors meet. However, a 1/8-in. clearance is indicated in the plans to prevent binding problems that could occur if the cabinet twists on an uneven floor.)

Hinged desk-flap supports must be positioned slightly lower than the flap to clear the hinge knuckle. Solid wood strips attached to the bottom surface of the flap make up the offset.

Nail Peg-Board inserts in the doors to 1 x 2 standoff strips to provide back clearance for the hooks. Cut thin wood strips, 1/4 x 3/8 in., to dress the inside corners around the perforated board, but do not attach them until after painting.

making the bulletin board

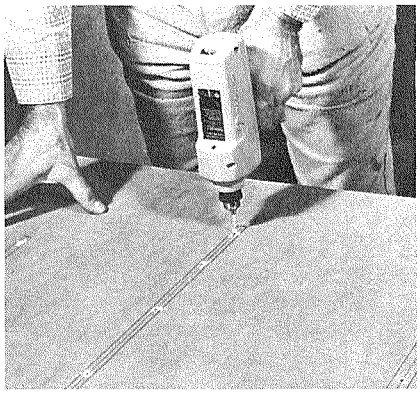
To make the the cork bulletin board, roll cork is contact-cemented to Homasote fiberboard. Trim the board to size after the cork is laminated. Use flathead screws and finishing washers to attach it *after painting.*

The novel crayon-shaped handles can be turned on a lathe or you can make them with a disc sander. Using the simple jig shown, feed the dowel slowly against the disc while rotating it continuously.

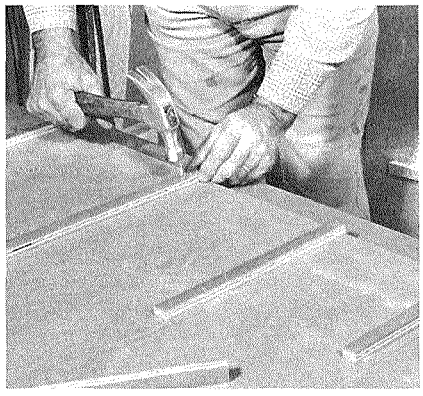
To drill holes in the crayon holder, assemble it without the permanent 1/8-in. bottom panel in place (use a temporary one for backup). Mark hole centers with an awl; then place the rack on a flat board on the drillpress table. A brad-point drill bit will enter the slanted surface readily without slipping or drifting.

After sanding the raw edges, give the entire cabinet a coat of primer; then paint it. To color-match the Crayola box, we used PPG No. D 4213 Sardonyx and No. N 7914 Lacquer Green. Desk and bench were coated with No. U 7245 Really Rust. Use masking tape for a sharp border between colors. Paint trim strips around the perforated-hardboard panels and attach them with 3/4-in. brads.

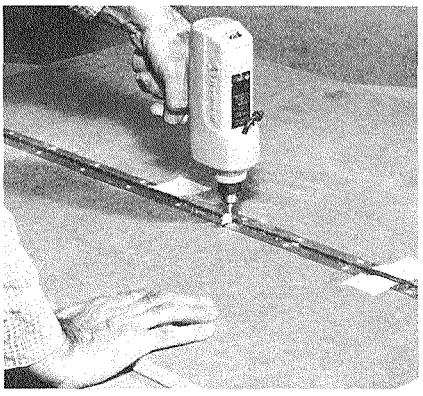
To letter the box, make a full-size template as



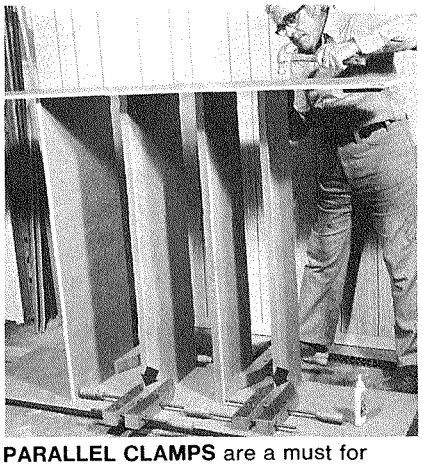
BORE LEAD holes for following nails along the center of all butt-joints. This helps center nails in mating pieces.



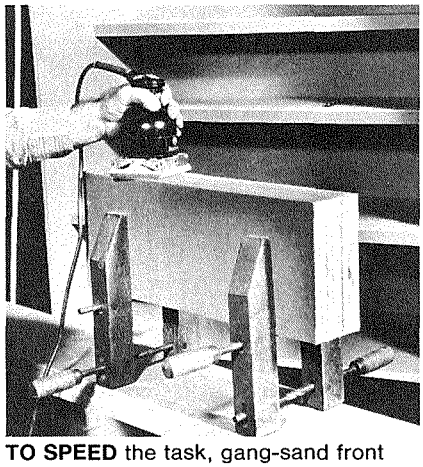
GLUED-AND-NAILED cleats help support the shelves and simplify assembly. Use galvanized nails for holding power.



FIT CONTINUOUS hinge to desk panel and flap before assembly. This beats working on your back.

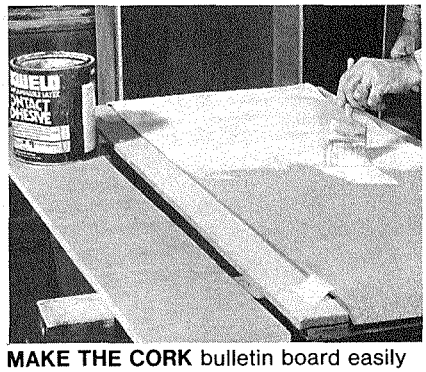


PARALLEL CLAMPS are a must for holding large shelves in place during assembly.

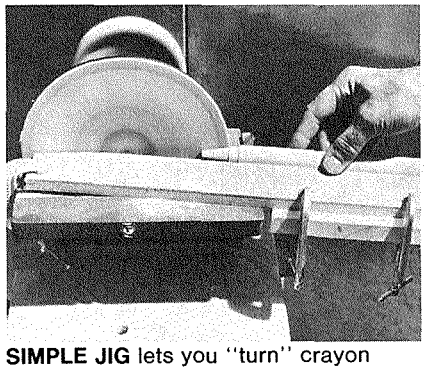


TO SPEED the task, gang-sand front edges of door horizontal members. Later ease all sharp corners.

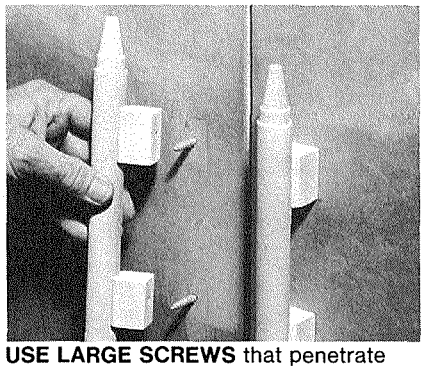
WITH DOORS resting in place on the cabinet, attach hinges. Shims are used to create a gap at the hinge edges.



MAKE THE CORK bulletin board easily by contact-cementing sheet cork onto Homasote board.

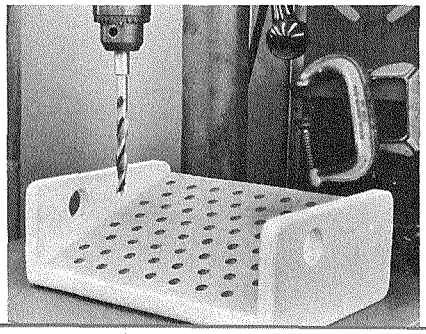


SIMPLE JIG lets you "turn" crayon handles with a disc sander. A working angle of about 10° creates crayon tip.



USE LARGE SCREWS that penetrate standoff blocks and enter hardwood dowels.

USE THIS SETUP for boring perpendicular crayon holes in the holder's angled surface. Use a brad point drill bit.



shown in the plans. Tape this on the box with pencil carbon beneath. Redraw the lines, using a straightedge and sharp pencil to transfer the logo. Use the green paint to fill the lines.

For a tough finish that you can wipe clean with water, let the paint cure several days, and then apply varnish as it comes from can.

Great ways to say Merry Christmas

There's sure to be at least one gift

By HARRY WICKS

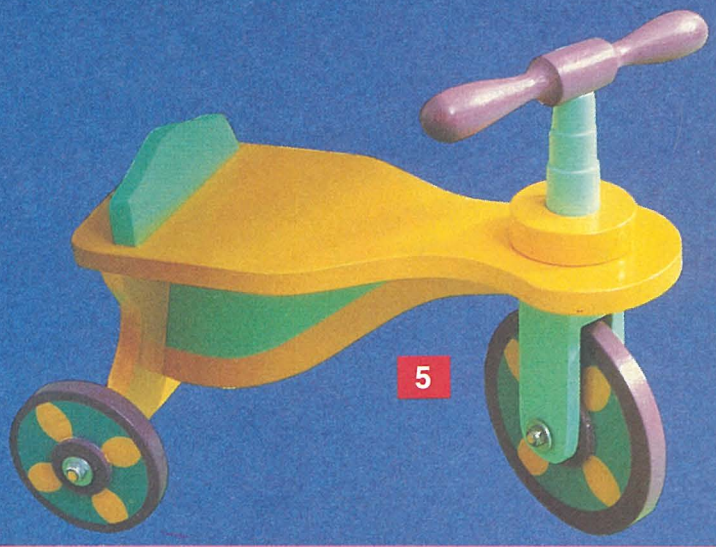
■ WE HAVE SELECTED here a roundup of gifts for Christmas giving. They are intended to give you great satisfaction when you make them—and even more when you give them to the special people in your life. Complete instructions for building the gifts are on these pages.

Before you begin construction of any of the items in this roundup, read the how-to instructions and study the art so you understand how the piece goes together. You will note throughout that construction

1 Gaily painted horse-on-a-stick is sure to please 3- and 4-year-olds. It is easy to build and will provide hours of fun.
2 Humming top is a great project for lathe buffs, and it's sure to become a family heirloom. Of walnut, it hums as it spins.
3 Colonial candlestand, finished in mellow pine, is a replica of those in museums and restorations. We help you build it fast.
4 Whimsical bread-cutting board is simply a miterbox shaped like a loaf—a sure conversation piece at your next holiday get-together.
5 A kiddy trike "like they used to make." Since most commercial toys are of plastic today, make your child a genuine wooden one.
6 The four-board bench was a useful piece of furniture in many Early American homes. Our plans will let you add one to your house.

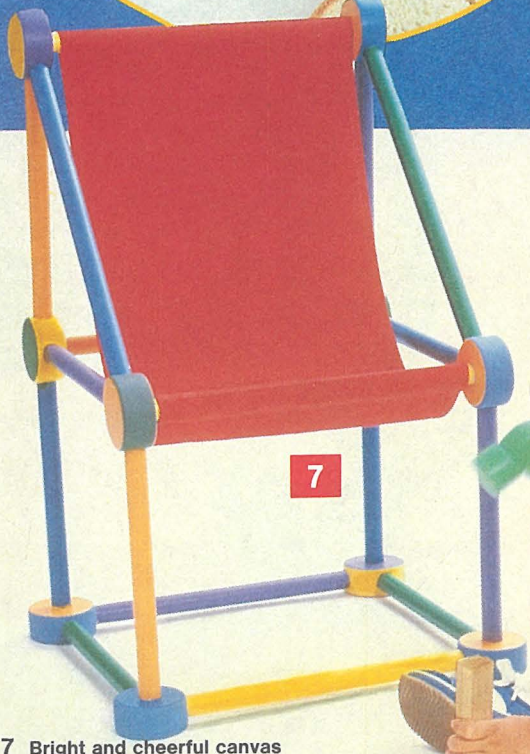
among these for each member of your family

4



5

6



7

7 Bright and cheerful canvas sling chair is styled in the manner of the famous Tinker-toys. Chair is easy to build using hefty dowels.

8 Dad's No. 1 assistant won't be able to resist helping out on the next home-improvement project when he gets these play tools.

8

has been kept simple—without sacrificing the craftsman-like quality that each project boasts. This way, you will have ample time to do those projects which appeal to you.

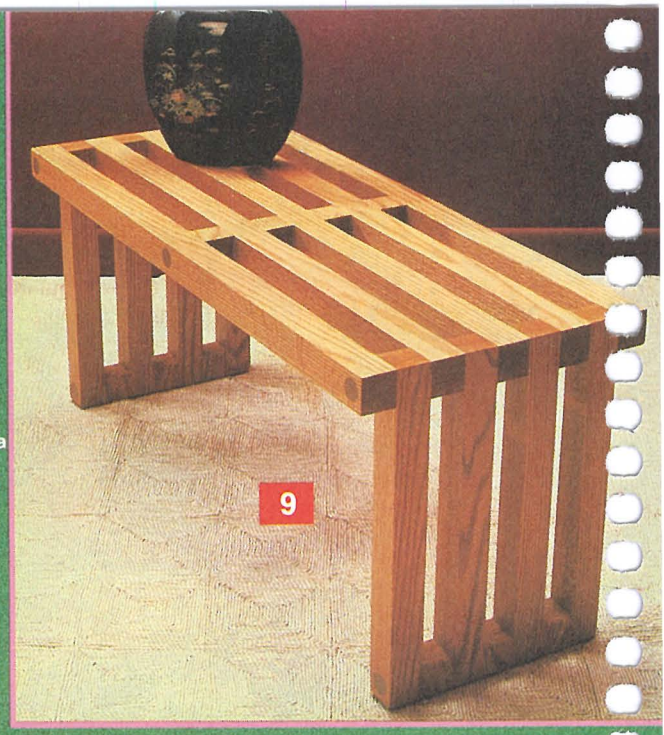
Except for a couple of projects, you do the majority of the building with low-cost pine and plywood. Use standard methods for working these materials. For all painted and varnished finishes, make certain you prepare adequately, as spelled out below.

9 Slats of oak and spacer blocks create this elegant coffee table. Wood is left natural, coated with satin-finish varnish.

10 Contemporary mirror is made of pine and spray-painted. A good workshop trick shows how to make it with very little material.

11 This cheery clown jumps a "rope" of soda straws when the toy is pulled. It will be a toddler's favorite gift this Christmas.

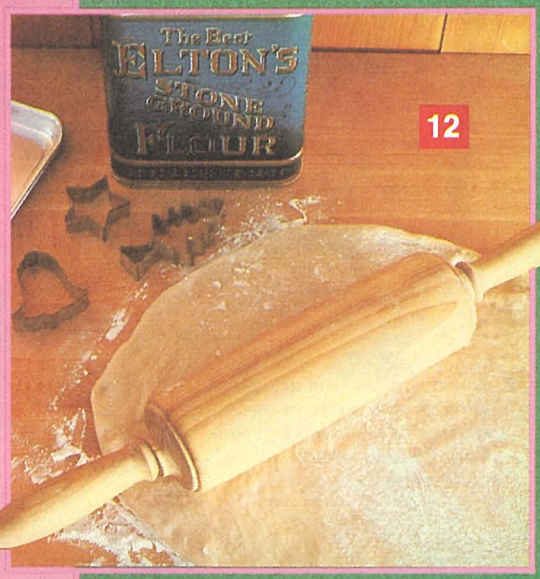
12 Old-time rolling pin is patterned after one found in an antique shop. Like the original, it is fashioned completely out of hardwood.



All materials can be cut with either portable or stationary power tools—or with a handsaw, if you prefer. All wooden members should be well sanded prior to assembly; finish up the raw wood with 150-grit sandpaper.

Use a minimal amount of either white glue or carpenter's glue for assembly. Always check for glue squeeze-out before staining; use a sharp chisel to remove any hardened glue that you may spot.

For maximum control, use oil stain wherever a natural finish is preferred. This type of stain gives



you greater working time, which means you can control depth of shade with less effort.

For durability, we recommend using varnish on the natural pieces. Wipe the workpiece with a tack cloth before applying the finish to obtain a smooth, professional look.

For best results, apply two coats of varnish, rubbing slightly with 180-grit paper between coats. Back up the abrasive paper with a block and carefully dust and tack off the piece before the final coat.

Because there isn't that much surface to be covered on these projects to be painted, the smartest move is to use one of the sprays in a can. These, when used properly, produce a professional-looking finish. The only exceptions here are the dowel chair and pieces to be decorated (kiddy tricycle). These should be painted with a brush.

Note: The materials for all of the projects except the clown pull toy and kid's toolbox are given on the drawings. The two exceptions have materials lists at the end of the how-to instructions.

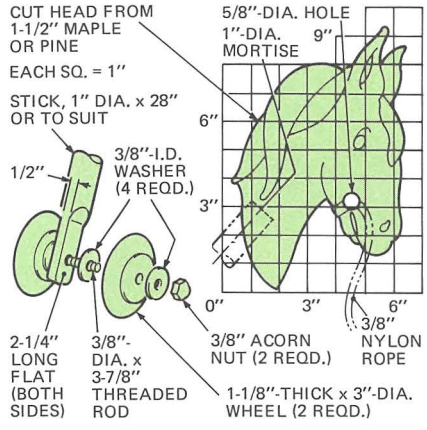
1 Horse-on-a-stick

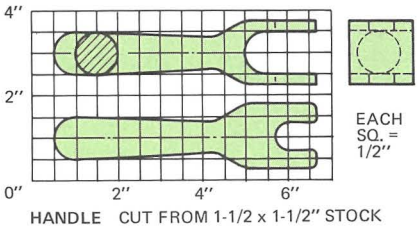
Make this toy and a favored grandchild can ride off into the sunset, just like grandpa did when he was 3 years old.

1. Cut out the head with a jig- or band-saw. Choice of lumber is optional, although softwood may be preferred.

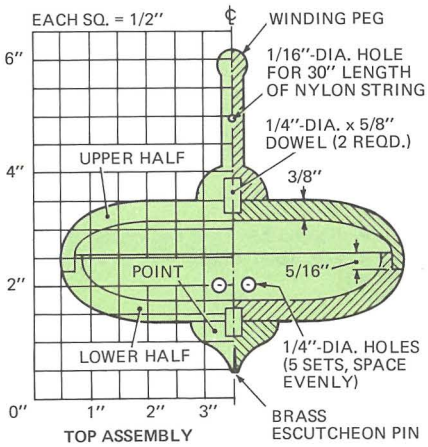
2. A pair of flats are cut at the bottom of the dowel to make a bearing surface for the wheel assembly. This can be done with the band- or jigsaw, or by hand with a backsaw.

3. The wheels are turned on the lathe or you can order wheels from Love-Built, 2907 Lake Forest Rd., Box 5459, Tahoe City CA 95730. (Send $1. for catalog.) Use a ⅜-in. threaded rod for the axle. Cap the axle with acorn nuts.





HANDLE CUT FROM 1-1/2 x 1-1/2" STOCK



TOP ASSEMBLY

2 Humming top

This hollow wooden top spins with a pleasing, low-pitched hum. Its tone is loudest when spinning at medium speed.

1. Make the top of hardwood, turning the walls no thicker than illustrated.

2. Cut two wood circles for the upper and bottom parts of the top about ¼ in. thicker than finished dimensions given. Glue each circle to a scrap-wood faceplate the same diameter as lathe faceplate.

3. Mount upper top-wood faceplate assembly on the lathe faceplate. Turn the outside to shape, then hollow out the inside. Remove from the lathe faceplate.

4. Mount lower top-wood faceplate assembly on the lathe faceplate. Turn the outside to shape given in diagram. Turn the lip at the edge and hollow out the interior.

5. Check fit of lip into top's upper part. The two should be a friction fit. With the halves together, bring the tailstock against the upper-portion wood faceplate. Turn down the wood faceplate to the diameter of tailstock. Back off the tailstock and complete the turning of the wood faceplate. Bring up the tailstock again to support the assembly and complete any needed turning for a smooth fit at the joint.

6. Use the lathe indexing device to mark locations of the five sets of "hum holes."

7. Cut the bottom of the assembly off the wood faceplate with a turning chisel.

8. Turn the winding peg. Bore the string hole; dowel and glue the peg to the upper portion of the top.

9. Turn the point dowel and glue it to the bottom. Bore a pilot hole in the point tip and tap in a brass escutcheon pin.

10. Bore the five sets of "hum holes" at previously marked locations.

11. Glue top and bottom together.

12. The spinning handle is 1½-in. turning square stock. Mount it between lathe centers and turn to dimensions given, leaving front end square. Lay out prongs of view A and saw out. Give the square a quarter turn, lay out the prongs of handle (view B) and saw out. Coat top and handle with clear finish.

To spin, use a 30-in. length of nylon fishline; tie a finger loop in one end. Thread the other end through the hole in the spindle and wrap the cord around the spindle. Slip a finger through the loop and set the top on a smooth floor, holding it between the prongs (B) of the handle. Give a steady pull to get the top spinning. At high speed, there is little sound; it increases with middle speed, then decreases as the lower speed is reached.

3 Candlestand table

Like the four-board bench, the Colonial candlestand was a fixture in the early American home. Its shape was dictated by the available materials and tools, as well as the skill of its maker. Our version is a variation of those in museums and restorations.

1. Start by cutting the pine stock for the top. Mark and bore for dowels and edge-join the boards. Clamp and set aside to dry overnight.

2. If you can get 2½-in.-thick pine stock, this table's pedestal is a good project to use it on. Most likely, though, you will have to glue up two pieces of 1⅛-in. and one piece of ½-in. pine to make up the thickness. Sandwich the thinner stock between the heavier and use glue sparingly on all surfaces to be joined. Clamp the piece securely overnight.

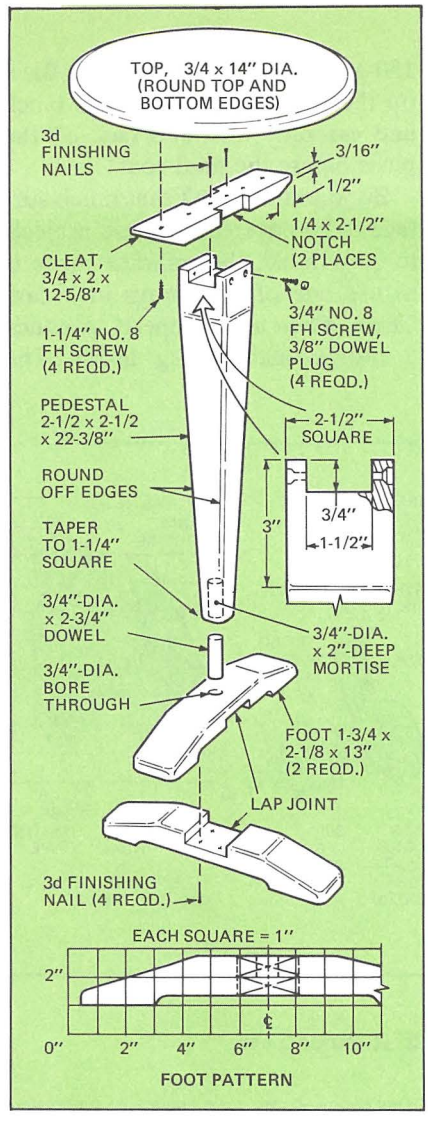
3. After removing the clamps, clean off all glue squeeze-out using a sharp chisel. With a pair of large dividers—or using the string and nail method—lay out the 14-in. circle for the top. Cut it out with band- or sabre saw. Sand the edge smooth with 100-grit paper and round the edges on both sides, using a ⅜-in. rounding-over bit in a router. Give the edge a sanding touchup.

4. Lay out the shape for the pedestal (leg) and cut it out using bandsaw or table saw. If cutting with the latter, refer to your saw manual for making taper cuts on the table saw. After cutting taper, notch the top end as shown.

5. Bore the bottom end at the center to receive the ¾-in. dowel which serves as a tenon. The dowel should extend at least 1¾ in. into the leg.

6. Cut the cleat and shape as shown in the drawing. Keep in mind that this must fit the leg neatly so check the fit as you construct this cleat.

7. Using the drawing as a guide, cut out the pattern for the feet. Trace this outline on the 1⅛-in. stock and cut out the feet.


TOP, 3/4 x 14" DIA. (ROUND TOP AND BOTTOM EDGES)
3d FINISHING NAILS
3/16"
1/2"
1/4 x 2-1/2" NOTCH (2 PLACES
CLEAT, 3/4 x 2 x 12-5/8"
1-1/4" NO. 8 FH SCREW (4 REQD.)
3/4" NO. 8 FH SCREW, 3/8" DOWEL PLUG (4 REQD.)
PEDESTAL 2-1/2 x 2-1/2 x 22-3/8"
2-1/2" SQUARE
ROUND OFF EDGES
3"
3/4"
1-1/2"
TAPER TO 1-1/4" SQUARE
3/4"-DIA. x 2-3/4" DOWEL
3/4"-DIA. x 2"-DEEP MORTISE
3/4"-DIA. BORE THROUGH
FOOT 1-3/4 x 2-1/8 x 13" (2 REQD.)
LAP JOINT
3d FINISHING NAIL (4 REQD.)
EACH SQUARE = 1"
2"
0" 2" 4" 6" 8" 10"
FOOT PATTERN

8. After the feet are shaped, round the edges and sand smooth. Join the feet using glue and small brads. Set aside to dry overnight.

9. Next day, bore the ¾-in. mortise at the foot center to receive the dowel tenon.

10. Because of its shape, the candlestand is almost impossible to smooth once it has been assembled. For this reason, check all the parts for smoothness before proceeding with assembly. Sand where needed and dust off all residue.

11. To assemble, start by gluing cleat into the notch at the top of pedestal. Use glue sparingly and hold the piece secure with three 1½-in. finishing nails. Bore for and install screws and dowel plugs as shown.

12. Put the top piece (good side down) on a clean work surface and locate the cleat on its bottom surface. With pencil, lightly draw cleat outline and then remove it. Apply glue sparingly to top surface of the cleat and reposition cleat on the top. Drive three 1¼-in. nails through the cleat to hold the setup rigid while you bore pilot holes for the 1¼-in. No. 8 fh screws.

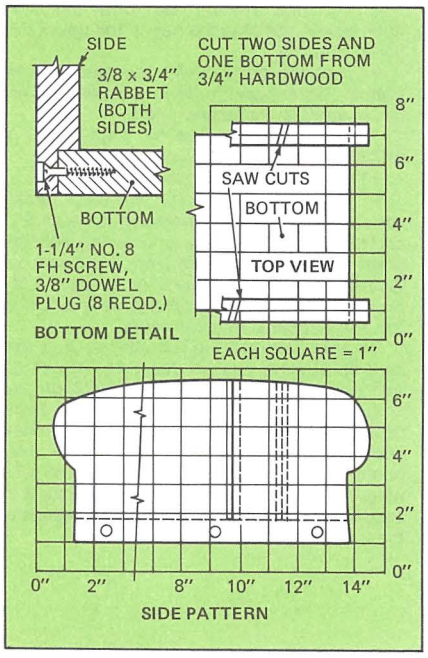
13. Next, apply a small amount of glue to the dowel tenon and insert it into the mortise in the foot. Check to make certain that the leg is square to the floor (feet) and place some weight on the tabletop. Allow assembly to dry overnight.

14. The next day, check all glue lines for squeeze-out and, if you spot any, remove with a sharp chisel.

15. Apply oil stain following the maker's instructions on label. On the stand shown, for a natural pine look, we mixed yellow ochre pigment from a tube with turpentine, a slight amount of boiled linseed oil and a little pine oil stain. (The stain was deliberately kept light.)

If you mix your own, test it first on scrap of the stock with which you built the stand. Apply the stain mixture with a brush, let it set 10 minutes or so and wipe off excess with rags. Set the stand aside to dry 24 hours.

16. Finish with two coats of varnish; for an authentic look use either flat or satin-finish. Sand lightly between coats with 180-grit paper, dust and wipe with a tack cloth.



4 Bread cutting board

This whimsical cutting board is sure to draw comments at your holiday buffet. It can be used with a conventional, saw-type bread knife or, if preferred, you can buy an inexpensive backsaw and use it exclusively for bread.

1. Cut the three boards to size as shown. Edge-rabbet bottom edges of boards (A).

2. On scrap ⅛-in. hardboard, plywood or cardboard, draw the loaf of bread outline following the drawing.

3. When you're satisfied with the shape, transfer it to the boards (A).

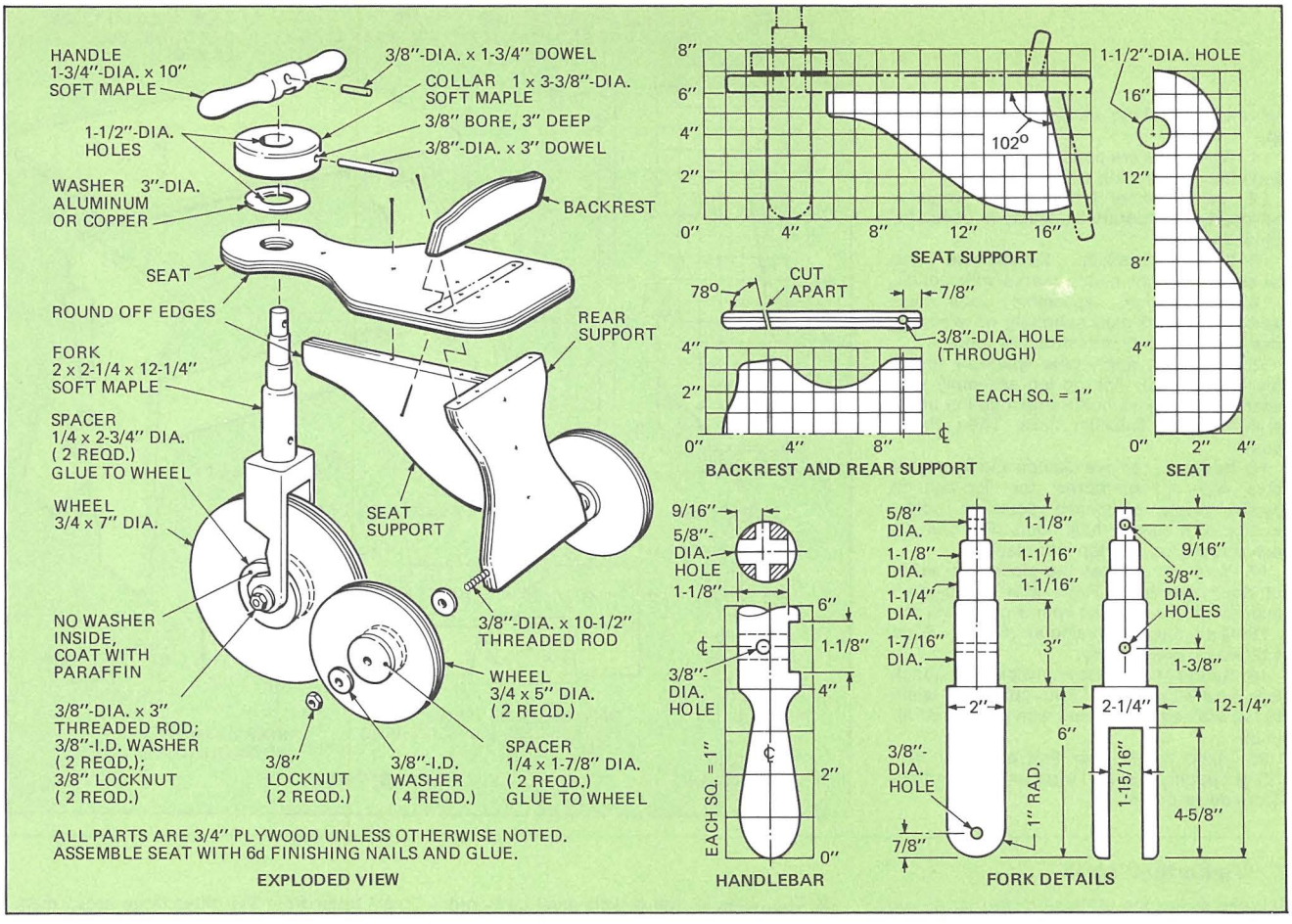
4. Tape both parts (A) together and cut them out at one time using jig- or bandsaw.

5. Sand all edges and surfaces smooth.

6. Assemble the miterbox using screws in counterbored holes. Put a dab of white glue in each hole and insert the dowel plugs.

7. Clamp the box in a vise and, with a fine crosscut saw, carefully make a miter cut down both sides (to the top surface of the bottom piece).

8. Finish the box with two coats of Salad Bowl Finish. (See Rolling Pin directions for source.)



5 Kiddy tricycle

This project requires just moderate workshop skills and toddlers will delight in using it. The original, from which this was copied, was finished with enamel and it endured for two generations of use.

1. Using the drawing as a guide, lay out the seat, seat support, rear support, backrest and wheel on plywood. Cut parts out using a sabre saw. Fill edge voids where necessary and sand all edges smooth.

2. Cut maple stock for the fork to size. Mount in lathe and turn shank as shown. Scribe semicircle on square end and drill ⅜-in. hole on center. Cut out semicircle and slot.

3. Next, mount the blank for the handlebar in the lathe and turn that piece. Remove from lathe and bore the mortise to receive the tenon. (The second hole for pinning the handlebar to the fork is bored after these parts are assembled.) Turn the hardwood washer.

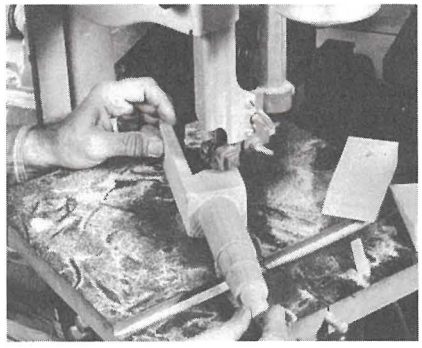
4. Assemble all the parts dry to check for fit. Disassemble and adjust dimensions if necessary.

5. When you're satisfied with the fit of all parts, reassemble the tricycle—using glue and hardware—as shown in the drawing.

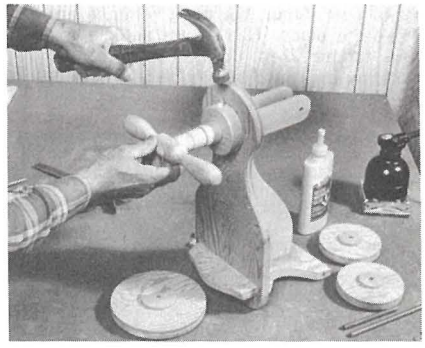
Note: Make certain you nail-fasten the rear support before installing the backrest. If you reverse the procedure, you won't be able to drive the nails through the top and into the support.

6. Apply a coat of primer to the tricycle and allow it to dry overnight. Next day, finish with enamels using the color photo as your guide.

Note: If there is any possibility of a child chewing on the toy, use only leadfree nontoxic paints to finish.



TURN the fork on the lathe; slot for the wheel is cut out on the bandsaw.



FORK IS HELD on trike by tapping a ⅜-in. dowel through collar and into fork.

6 Four-board bench

It is almost impossible to visit a recreated Colonial village or a museum without seeing at least several versions of the four- and five-board benches that were so popular with the early settlers. As the name implies, the simple benches are assembled using a certain number of boards: The four-board type features a stretcher between legs, while the five-board eliminates the stretcher and adds a pair of skirts directly below the top board.

This version was created by the author after visiting many restorations and studying countless numbers of such benches.

1. Rip the ¾-in. stock to necessary widths and plane the edges to be joined.

2. Join boards to create the widths necessary for top and legs using dowels and glue. Do the same to create the thick board for the stretcher.

3. Clamp the glued-up pieces securely and allow them to dry overnight.

4. Trace the patterns for the legs onto a piece of ¼-in.-plywood scrap; when satisfied with shape, cut it out using a band- or sabre saw. Sand pattern edges smooth.

5. Remove clamps from glued-up pieces.

6. Cut both legs to length with radial or table saw set to cut at angle shown.

7. Place pattern on legs and draw outline with pencil. Cut legs out using band or sabre saw. Then smooth all edges.

8. Cut mortise in legs (repeat angle used for leg tops and bottoms). Round all edges with a rounding-over bit and router; sand smooth.

9. Round and sand edges of top piece.

10. Place top—top surface down—on work surface; carefully locate leg positions. On inside surface of legs, partially drive sev-

eral 1½-in. finishing nails through legs into top.

11. When legs are positioned, measure between them for cutting ends of stretcher.

12. Cut stretcher tenons—note angle—and insert in temporary assembly to check fit. Adjust and trim.

13. When satisfied, disassemble the pieces; make light match marks with pencil.

14. Using glue, assemble legs and stretcher; spread glue sparingly on wedges; drive them securely into stretcher tenons.

15. Next day, apply glue sparingly to leg tops and carefully line up leg assembly with match marks. Again, hold setup together using partially driven finishing nails. Then clamp rigidly.

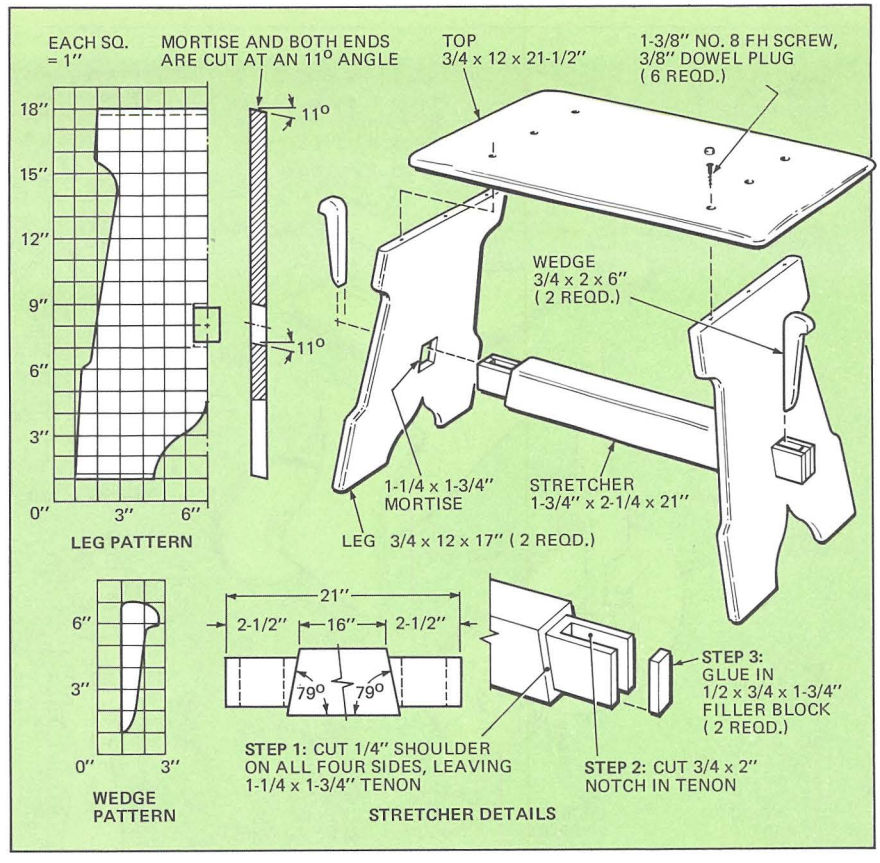
16. Next day, remove clamps and bore pilot holes with counterbores for top-holding screws. Apply moistened soap to screw threads; turn screws fully home. Put glue on each dowel plug and tap into place.

17. You can distress the piece if desired, but don't overdo it. Raps with a ball-peen hammer and/or smacks with a chain will do.

18. Stain the piece using an oil stain. Wipe as directed; allow to dry.

19. Sand lightly, dust and wipe with a tack cloth. Seal with a coat of 3-lb.-cut, water-white shellac thinned 50 percent with denatured alcohol.

20. Sand lightly after first coat with No. 180-grit paper; dust and wipe with a tack cloth before second coat.



7 "Tinkertoy" chair

You can make one of these chairs, or set up your shop production-style if you want to make a set of four. You need 6/4 maple stock to make the discs. This allows sufficient thickness for the ⅞-in. dowels. Do not use softwood for the round pieces because it tends to split at the thin wall section.

1. Rough-cut the discs with a band or jigsaw; then turn them to size on the lathe. Sand.

2. The holes for the dowels must be bored with accuracy, so it's best to use a drill press and vise. All holes are bored to a depth of ¾ in. Note that the front center discs are not interchangeable, so you must be sure to make a left- and right-side disc when laying out the hole centers.

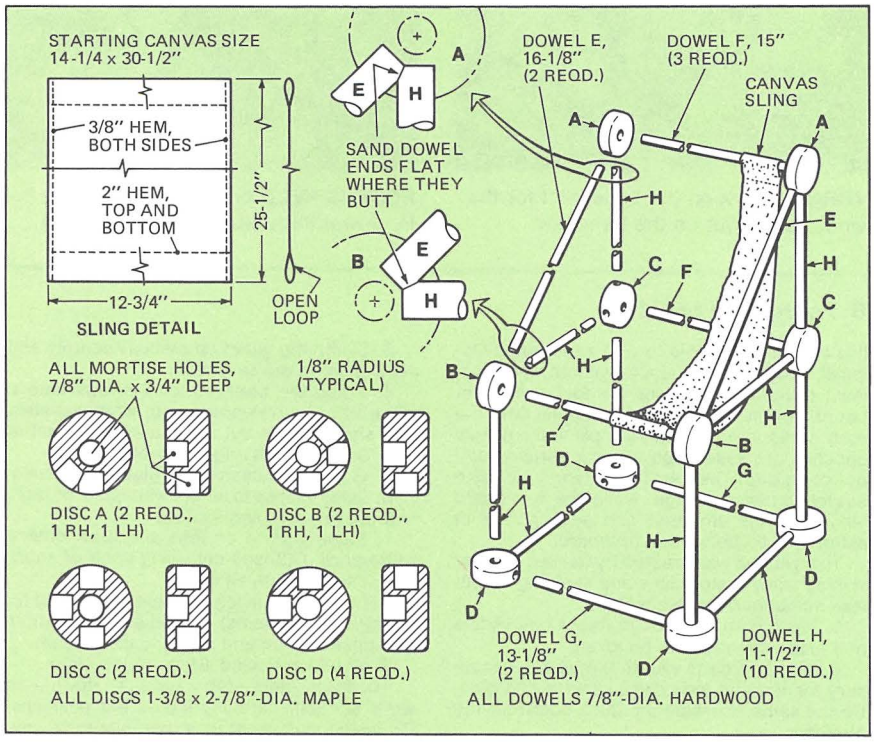
3. Cut the dowels to length, observing that the size of the two bottom dowels (front and rear) differ from the other three cross members. Sand a slight flat at the ends of those dowels that insert at angles under 90° (front center and top). Insert one dowel into the hole and mark the cutoff with a pencil. The ends of both adjoining dowels must be treated this way.

4. Test-fit all parts in a dry assembly. Begin assembly by gluing up the left- and right-side sections, working from the base up. Don't glue the cross members until later. When both side sections have been glued, install the cross members *dry*. This insures that all discs will be in alignment as the glue sets. Before inserting the cross members, check to make sure that no glue has oozed into the side dowel holes. This could happen because the drill-bit point makes a small through-hole. If glue is present, remove it.

5. Prime all wooden parts with shellac and set aside to dry.

6. Paint the various pieces in a variety of colors as on the original.

7. Cut the canvas to size, using chalk mark for the loops, and take it to the local shoe-repair shop for sewing (unless your wife has a machine that will sew this material).


STARTING CANVAS SIZE 14-1/4 x 30-1/2"
3/8" HEM, BOTH SIDES
2" HEM, TOP AND BOTTOM
25-1/2"
12-3/4"
OPEN LOOP
SLING DETAIL
SAND DOWEL ENDS FLAT WHERE THEY BUTT
DOWEL E, 16-1/8" (2 REQD.)
DOWEL F, 15" (3 REQD.)
CANVAS SLING
ALL MORTISE HOLES, 7/8" DIA. x 3/4" DEEP
1/8" RADIUS (TYPICAL)
DISC A (2 REQD., 1 RH, 1 LH)
DISC B (2 REQD., 1 RH, 1 LH)
DISC C (2 REQD.)
DISC D (4 REQD.)
ALL DISCS 1-3/8 x 2-7/8"-DIA. MAPLE
DOWEL G, 13-1/8" (2 REQD.)
DOWEL H, 11-1/2" (10 REQD.)
ALL DOWELS 7/8"-DIA. HARDWOOD

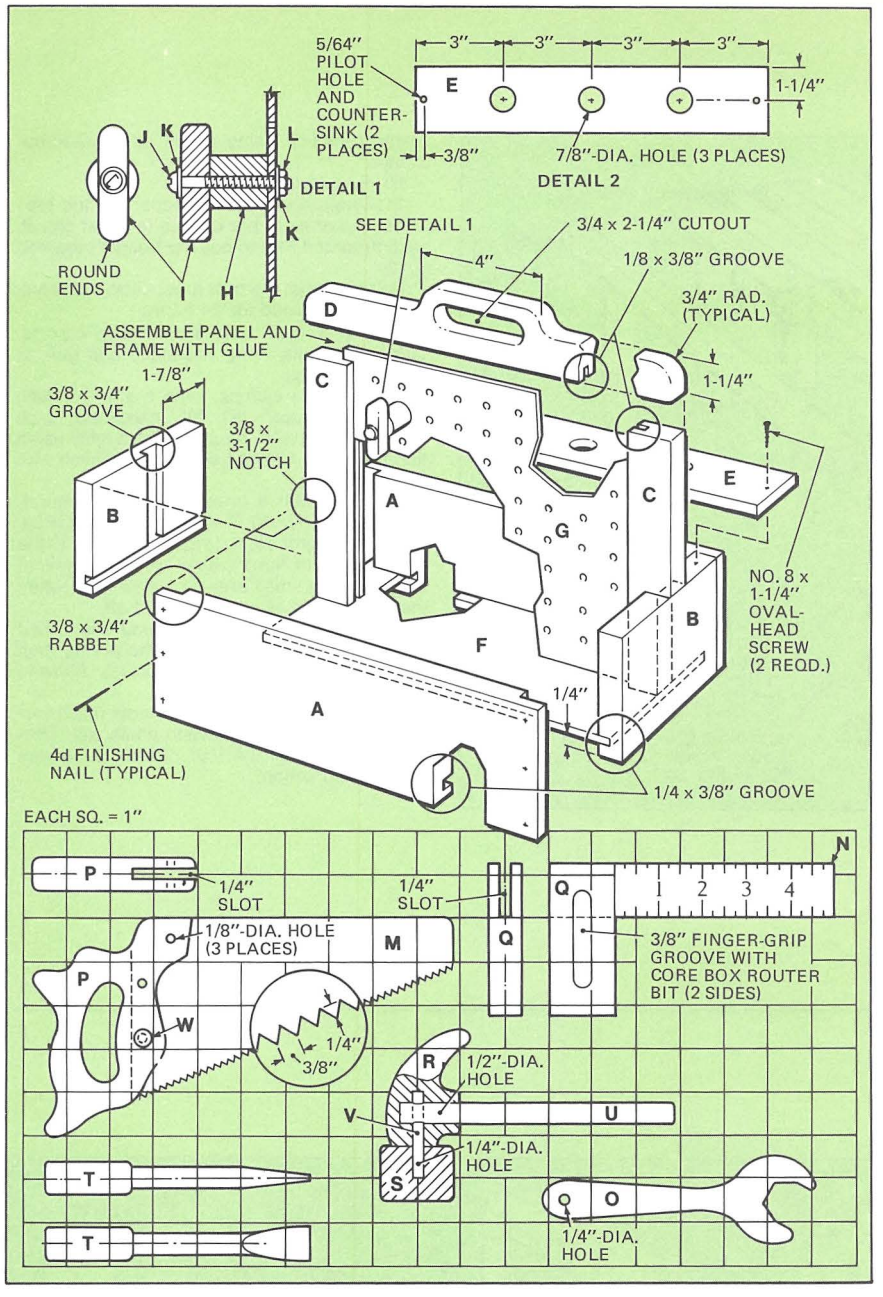
8 Play tools

If you have a toddler who likes to follow you around the house while you perform house chores, you can promote him to assistant by building this set of duplicates of all his favorite tools. As you can see in the drawings, all construction is simple. Here are construction tips:

1. Cut the slots for both the saw and the try-square blades before cutting the handles to their final shapes.

2. Use a tenoning jig when cutting end slots.

3. Assemble the try square with brads and white glue, but for authenticity, get real ¾-in.



MATERIALS LIST—TOOLBOX

Key	No.	Size and description (use)
A	2	¾ × 4 × 12" pine (sides)
B	2	¾ × 4 × 5-¼" pine (ends)
C	2	¾ × 1-⅜ × 8-½" pine (vertical frame)
D	1	¾ × 2-⅛ × 12" pine (horizontal frame)
E	1	½ × 2-¼ × 12" pine (toolrack)
F	1	¼ × 5-¼ × 11-¼" hardboard (bottom)
G	1	⅛ × 8-⅞ × 10" perforated hardboard
H	1	⅞" dia. × 1" dowel (spacer)
I	1	½ × ½ × 2" turnbutton
J	1	3/16 × 1-¾" machine screw
K	2	3/16" washers
L	1	3/16" hex nuts
M	1	¼ × 5 × 7-½" overall, veneer core plywood (saw blade)
N	1	¼ × 1-¼ × 6-½" veneer core plywood (try square blade)
O	1	¼ × 2 × 7" overall, veneer core plywood (wrench)
P	1	¾ × 4 × 5" pine or oak (saw handle)
Q	1	¾ × 1-½ × 3-½" pine or oak (square handle)
R	1	1-1/16 × 2 × 3" overall, oak (hammer head, claw and cheek).
S	1	1-⅝" dia. × 1-¼" oak (hammer head, poll)
T	1	¾" dia. × 6" hardwood dowel (screwdriver)
U	1	½" dia. × 6-¼" hardwood dowel (hammer handle)
V	1	¼" dia. × 2" hardwood dowel (hammer pin)
W	3	Brass paper clips

brass saw screws at your local hardware store.

4. The claw half of the hammer head and the wrench are cut out on a bandsaw. Before you cut the final claw shape, bore the assembly holes. Assemble head dry and finish with two coats of spray paint. When paint is dry, disassemble head, dab on some glue and insert handle. Reassemble permanently.

5. To shape the screwdriver, you need a lathe and a belt sander. Our version is sized so that you can use a 6-in. lathe (like Dremel's Mini-Lathe) to turn the shank and flared tip. Sand the flats on the blade with a belt sander.

6. The toolbox itself is straightforward and simple. If a lighter version is preferred, you can substitute ½-in. pine for the ¾-in. stock and adjust dimensions accordingly. Paint the perforated board before assembling the box and break all sharp wood edges with sandpaper. Round the outer edges of the center panel frame with a ¼-in. rounding-over bit and router. Assemble with white glue and nails.

7. The toolbox shown was left natural and finished with two coats of polyurethane varnish.

When the varnish is dry, install the saw-holding turnbuckle. Use epoxy adhesive to hold the perforated-board hooks in place—and out of the mouth of the child.

9 Oak coffee table

For looks, our contemporary table was created of red oak, left natural and simply varnished. Other wood can be substituted, if desired and available. But, because there is no stretcher in this design, we recommend avoiding softwoods such as pine because they aren't rigid enough. To keep down costs, buy 2-in. nominal oak and rip the pieces to size.

1. Check the thickness of the oak and rip the plank into strips of the same width. If, for example, your oak stock is 1 7/16 in. thick instead of the full 1½ in., rip the strips 1 7/16 in. square. For looks, if any edge requires planing, plane the same amount of stock from the face of one of the perpendicular surfaces to maintain the square. *All* strips should be exactly the same dimension.

2. Cut strips for top and legs to length.

3. Cut the 10 filler blocks.

4. On a large work surface, line up the parts as they will be assembled in the finished table. At this time, make certain that the wood grain of all boards is similar. On the table shown, the face grain (of the original board) is on the outside surface all around—the horizontal surfaces of the top slab and the vertical surfaces of the legs.

5. Carefully mark all boards for the holes to be bored through for the threaded rod. Bore the holes through all pieces.

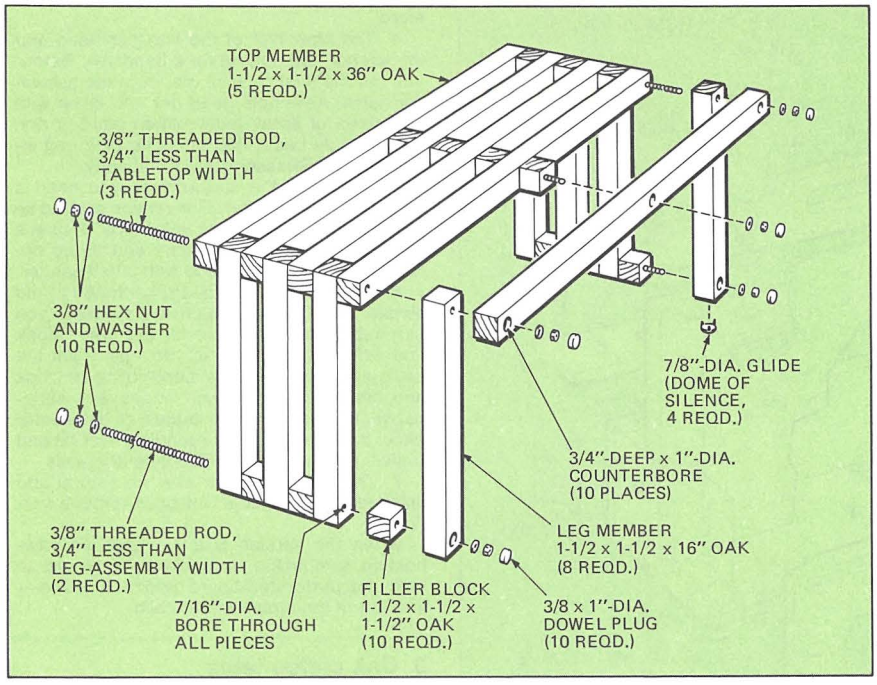
Note: Before boring holes in any of the pieces, make special marks on the outside strips—there should be 10 marks in all—for the holes to be counterbored to receive the plugs. Counterbore ¾ in. deep before boring the 7/16-in. hole in all remaining boards.

6. Line up all strips and filler blocks on a large work surface. Also, have the precut threaded rods, washers, nuts, glue and the two socket wrenches handy.

7. Assemble the top strips and both legs using glue *sparingly* between strips and blocks. Slide a rod through each strip as you add it.

8. When all parts are assembled, slip the washers over both ends of all threaded rods and run the nuts *just finger-tight.*

9. Working one end at a time, rotate the leg upright and check the angle with a square (it must be 90°). Temporarily hold the leg in the



correct position using props or hand-screw clamps.

10. Repeat for second leg.

11. When both legs are square to the top, use seven or more bar clamps (at least one at each threaded rod) to pull the boards together tightly.

Do not tighten the nuts now. Allow the setup to rest undisturbed for 24 hours.

12. Next day, before removing clamps, tighten the nuts using wrenches and glue in the dowel plugs.

13. Remove clamps. With a sharp chisel, carefully scrape off all hardened glue squeeze-out. Sand the piece thoroughly using first 80-, then 120-grit sandpaper. Finish with 150-grit.

14. Dust with a brush and apply natural-paste wood filler (to fill the oak's open pores). The general procedure is to thin the filler to the consistency of light cream using turpentine. Brush it on a small area at a time, and when the liquid loses its sheen, wipe it off.

When wiping, the best procedure is to first rub across the grain to pack the pores, then with the grain to clean off the excess. Allow to dry at least 24 hours.

15. Finish with two coats of satin-finish varnish, sanding lightly between coats with 180-grit paper. Install the four glides (to prevent any rocking action).

10 Contemporary mirror

This project is a good example of less being more. We used supersimple construction techniques to create the rounded corners.

1. Cut clear pine stock to 2½-in. width.

2. Lay out and assemble the frame using dowels at all four corners. Use glue to assemble and clamp the setup after checking corners for square. Tack diagonal bracing to the frame (on the back side) to keep it square during clamping. (*Note:* You can also clamp the four frame members and then secure the corners using corrugated fasteners or Skotch connectors—two per corner—on the back side.)

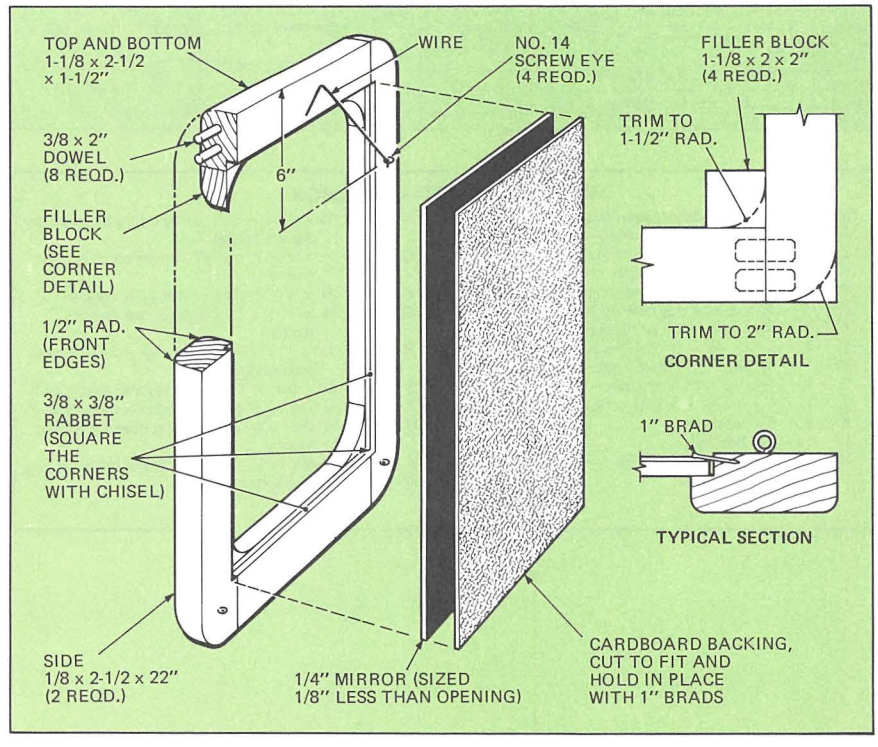
3. While the setup is still clamped, apply glue sparingly to the four filler blocks and position them at the four corners. These are held with *glue only*. So clamp them securely once they are positioned. Allow the setup to dry overnight.

4. Next day, remove clamps and scrape off all glue squeeze-out using a sharp chisel. Sand the frame, stroking the paper with the grain on each side. Start with 80-grit paper, move up to 120-grit, then finish with 150-grit.

5. Draw one corner of the pattern (of the inside and outside corners) on a scrap piece of thin plywood or hardboard; cut out the corner pattern using a band saw or sabre saw. Sand the pattern edges smooth. Make registration marks for lining up the pattern at each of the frame's four corners.

6. Transfer shape to frame and cut out all four corners, inside and out, using band, jig- or sabre saw.

7. Sand all edges smooth.



8. Shape the inside and outside frame edges on the front, using a ½-in. rounding-over bit in a router.

9. Switch to a ⅜-in. rabbet cutter and, on the back side, cut the rabbet to receive the mirror. Using a ruler and pencil, run the lines out for the corners and cut square corners in the rabbet using a sharp chisel. Measure length and width of rabbets; then deduct ⅛ in. in width and length and order the mirror to suit.

10. Dust, wipe with tack cloth and apply prime coat of paint.

11. Finish with the color of your choice.

12. When dry, place mirror on a soft surface so paint won't be marred, and install screw eyes and picture wire.

In order to keep the mirror from tilting in at the bottom, install a pair of screw eyes near the bottom edge.

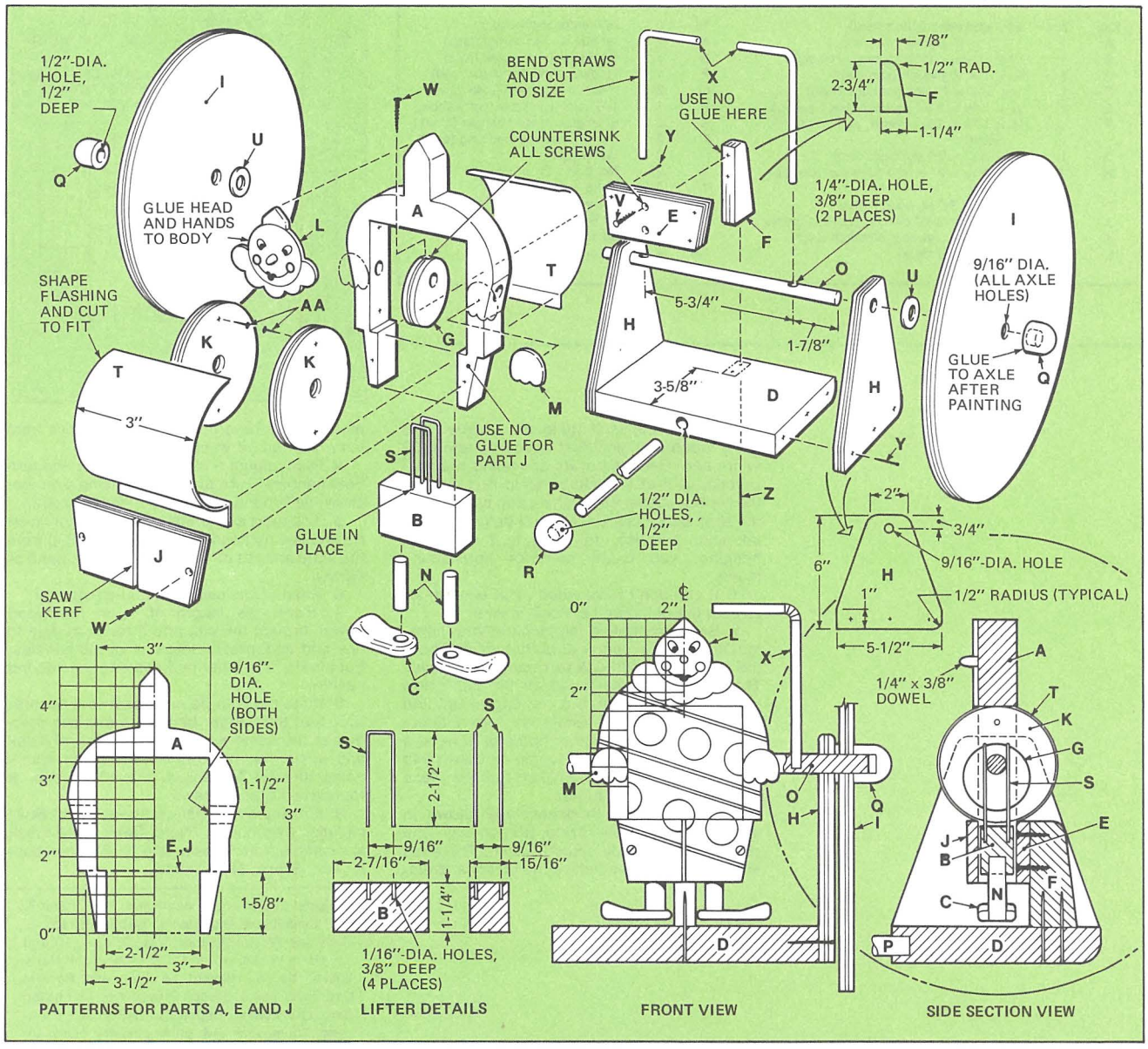
13. Insert the mirror and back it up with a piece of cardboard. Use 1-in. brads to hold cardboard and mirror in the frame.

14. Hang the mirror from a stout picture hanger.

11 Clown pull toy

This toy is fun to build and out of the ordinary. Toddlers will roar their approval of the clown jumping over his "rope" of straws. Built mostly of scraps, it's easier to make than you might suspect.

1. Lay out the basic body on white pine. While it is still in block form, mark the locations of the dowel axle holes and stop-drill into each


1/2"-DIA. HOLE, 1/2" DEEP
GLUE HEAD AND HANDS TO BODY
SHAPE FLASHING AND CUT TO FIT
SAW KERF
BEND STRAWS AND CUT TO SIZE
USE NO GLUE HERE
COUNTERSINK ALL SCREWS
1/4"-DIA. HOLE, 3/8" DEEP (2 PLACES)
9/16" DIA. (ALL AXLE HOLES)
GLUE TO AXLE AFTER PAINTING
USE NO GLUE FOR PART J
GLUE IN PLACE
1/2" DIA. HOLES, 1/2" DEEP
9/16"-DIA. HOLE
1/2" RADIUS (TYPICAL)
1/4" x 3/8" DOWEL
9/16"-DIA. HOLE (BOTH SIDES)
1/16"-DIA. HOLES, 3/8" DEEP (4 PLACES)
PATTERNS FOR PARTS A, E AND J
LIFTER DETAILS
FRONT VIEW
SIDE SECTION VIEW

side (so the drill bit will penetrate into what will be a cavity).

2. Carefully cut out the body outline and cavity.

3. Cut all remaining parts to size as shown (see the artwork and the materials list on page 180). The leg block is cut from the same solid pine block as the body.

The bent coat-hanger-wire suspenders are anchored into the leg block with Wonder Glue. Simply pile the glue around the inserted wire.

4. Cut the ¼-in. plywood side pieces and glue in place. Round them evenly so that the metal cowling will form properly.

5. Lay out and cut cam. Secure cam to the ½-in.-dowel axle with a countersunk screw through the short distance of the cam into the axle.

The cam used will give about ¾-in. lift. Make certain you allow enough room below the block for the legs to drop and rise without binding.

6. Construct the carriage as shown (following page) and bore the holes with the carriage sides together to assure axle alignment.

Assemble the carriage pieces.

7. Cut the wheels from ⅜-in. plywood stock.

8. Lay out all holes along the axle. Note that two axle covers keep the axle in place.

9. Cut the stomach metal cowling from aluminum flashing.

10. To get working parts assembled, remove one or both of the aluminum covers and insert axle carriage sides under wire suspender.

Insert axle through the cam hole and out through the other side. Then turn the cam screw home.

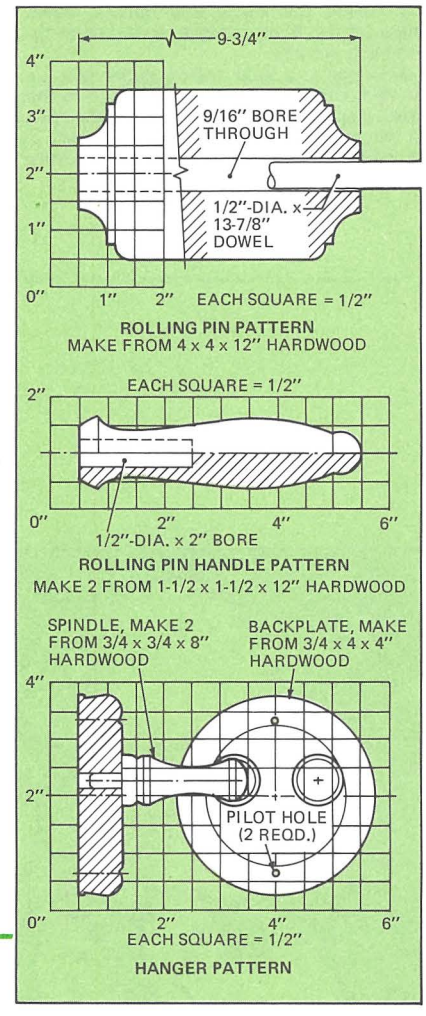
Attach cowl cover (or covers).

11. Sand all the parts smooth and paint them.

Be careful when you are painting the axle; paint buildup at the axle ends will cause binding.

MATERIALS LIST—CLOWN TOY

Key	No.	Size and description (use)
A	1	1 × 5 × 7″ overall, pine (body)
B	1	15/16 × 1-¼ × 2-7/16″ pine (leg block)
C	2	½ × 1 × 2″ overall, pine (feet)
D	1	1 × 5-½ × 7″ pine (carriage base)
E	1	½ × 1-⅝ × 3-½″ plywood (back support)
F	1	½ × 1-¼ × 2-¾″ overall, plywood (back brace)
G	1	1-¾″ dia. × ½″ plywood (cam)
H	2	⅜ × 5-½ × 6″ overall, plywood (carriage sides)
I	2	12″ dia. × ⅜″ plywood (wheels)
J	1	¼ × 1-⅝ × 3-½″ overall, plywood (pants)
K	2	3″ dia × ¼″ plywood (stomach discs)
L	1	⅛″ hardboard (face)
M	2	⅛″ hardboard (hands)
N	2	½″ dia. × 1-¾″ dowel (legs)
O	1	½″ dia. × 9-½″ dowel (axle)
P	1	½″ dia. × 24″ dowel (pull rod)
Q	2	1″ dia. × 1″ dowel (axle cover)
R	1	1-½″-dia. wood ball (pull handle)
S	2	6″ lengths of coat hanger (lifters)
T	2	3 × 6″ aluminum flashing (belly)
U	2	9/16″ washers
V	2	No. 8 × 1-¼″ fh screws
W	3	No. 6 × ¾″ fh screws
X	2	straws with a flexible joint
Y	10	3d finishing nails
Z	2	6d finishing nails
AA	4	¾″ brads



12 Rolling pin

Though this pin isn't quite an antique, it is likely that the original first appeared about 60 years ago. Because of its appealing shape, I purchased it at an antique shop and created the replica shown on a lathe using poplar from my shop scrap bin. If yours will be used for its intended purpose, rather than just a wall hanging, you might consider substituting maple.

1. If you don't have wood thick enough for turning the pin, glue up stock to size.

2. Before mounting the block in your lathe, locate the block center at both ends and bore the 9/16-in. hole through to receive the dowel. The pin shown was bored on the drill press using a bit extension, but you can mount and bore it on your lathe. Either way, mark accurately and bore with either press or lathe at a low speed. Glue a short length of dowel into the waste area at both ends so that the piece can be mounted for turning.

3. Turn the pin to dimensions shown in drawing. Finish the rolling portion with the skew for a perfectly smooth finish. The ends are shaped with the half-round chisel and diamond point. Sand if necessary. Remove from lathe and cut off waste portions.

4. Next, mount a block in the lathe and turn both handles. Turn the handles using a gouge, skew, half-round chisel and diamond point.

5. The balls at the tips of the handles must be finished by hand. Remove the turning from the lathe and cut off the waste, using a band or jigsaw.

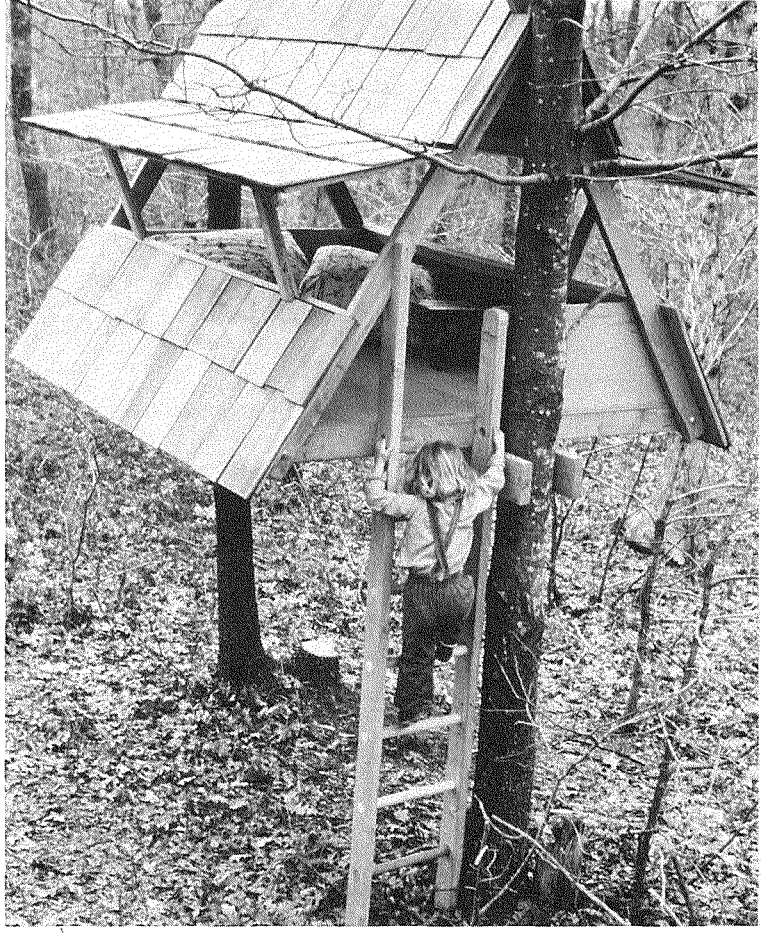
6. Shape balls using file and sandpaper.

7. Insert the length of ½-in. hardwood dowel through the pin, add a touch of glue to one end and insert it into one of the handles. Put glue on the other end and add the second handle.

8. If the pin is to be used as a wall decoration, turn the hanger backplate and two spindles of the same wood. Bore the pair of holes and insert the pin tenons. Bore two shank holes through to receive the 1¾-in. No. 8 roundhead brass screws.

9. Finish pin and hanger using Salad Bowl oil finish (two coats). (Note: Salad Bowl finish is available from Constantine, 2050 Eastchester Rd., Bronx, NY 10461.)

Projects' design and construction: Nos. 1 and 7, C.J. Castelberry and Rosario Capotosto; No. 2, Elma and Willard Waltner; Nos. 3, 6, 9, 10 and 12, Harry Wicks; No. 4, Doug Eisman and Harry Wicks; No. 5, Harvard Leighton and Rosario Capotosto; No. 3, Joseph Provey; No. 11, Merton Siutz and Rosario Capotosto; technical art: Eugene Thompson; PM photos: Harry Hartman; styling, Gabe Herrick.



Build a tree-top hideaway for your youngsters

By HARRY WICKS

Get some help from a neighbor as well as your own kids to build this sky-high, A-frame structure

NOT ALL DO-IT-YOURSELF is of the maintenance, must-do variety. The tree house shown on these pages is a good example of a project that is lots of fun to build, as well as use. If your youngster is old enough to want a tree house, he is also old enough to share in a rewarding building experience. This project is a fine opportunity for Pop to pass along some know-how, and for Junior to appreciate the value of using something he has built himself.

The house shown is one of four designs offered in *The Tree House Book* by David Stiles (copyright 1979, Avon Books). We chose the A-frame for its simplicity of design and ease of construction. Building details on page 170 clearly spell out how the structure goes together, although the book provides additional drawings not shown here.

preliminary planning

Start by picking the two trees which the unit will be built in. Ideally, these will be in the kids' corner of the yard and away from gardens, decks and the like. They should be sturdy and healthy, and the site should be within easy view of the house.

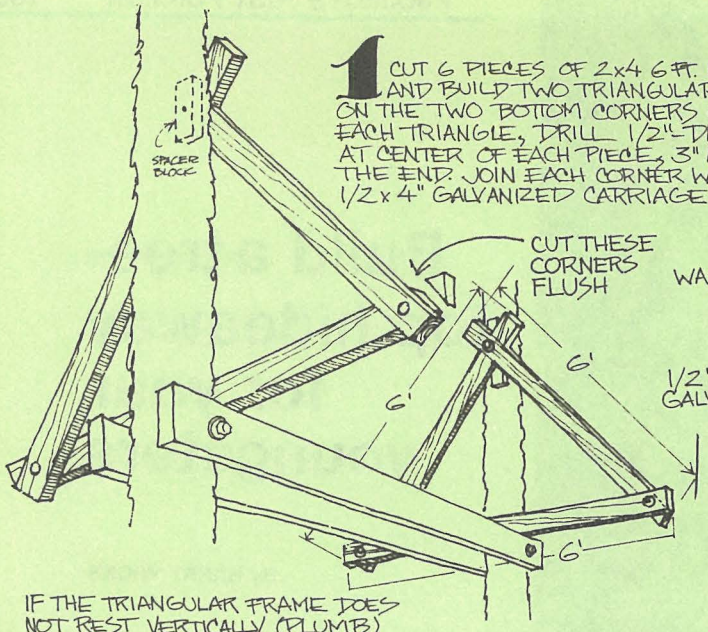
Locate the floor no more than 6 ft. above the ground. Greater height adds nothing to the tree-house effect and, in fact, can make it more difficult for occasional parental inspections.

If you decide to create any custom items (such as built-ins) on your tree house, give priority consideration to safety. For example, do not overbuild walls or openings so that it would be impossible for an adult to squeeze through them. Make certain that no locks are used on the outside of the house to avoid any chance that one youngster might lock another one inside. And be sure that access ladders, ropes and the like are permanently affixed.

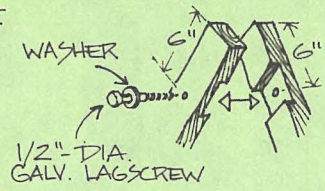
A good safety feature to consider is a "soft" area beneath the structure. To install it, simply lay out a square or rectangle approximately 6 ft. wider and longer than the structure itself. Install a perimeter of 2 x 6s. Excavate the interior to a depth of 6 in., then fill the hole with mason's sand.

selecting materials

You may prefer to paint your completed house but the wisest route is to pick materials that call for a minimum of maintenance—yet retain their looks. By selecting either redwood or pressure-treated lumber you will eliminate time-consuming and expensive periodic painting. Both types of wood age to a handsome silver patina



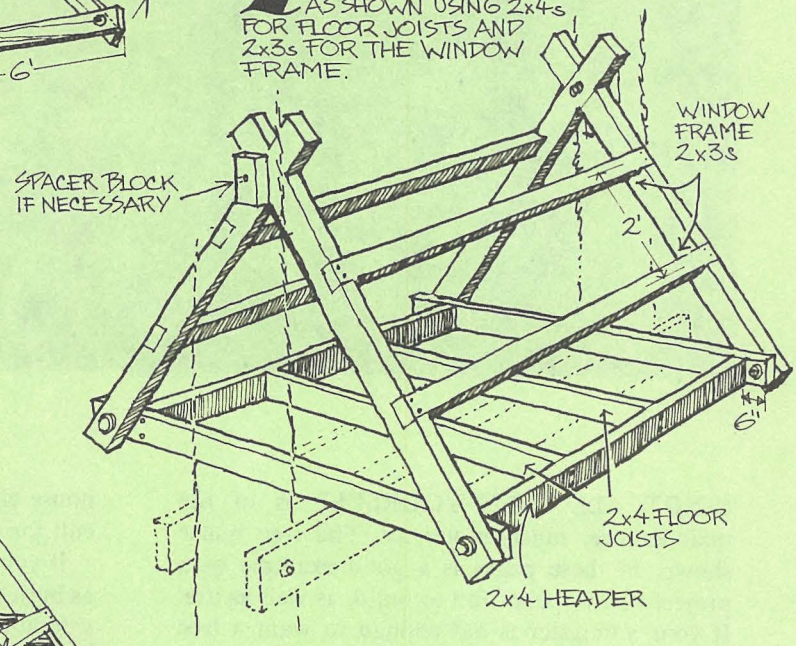
1 CUT 6 PIECES OF 2x4 6 FT. LONG AND BUILD TWO TRIANGULAR FRAMES. ON THE TWO BOTTOM CORNERS OF EACH TRIANGLE, DRILL 1/2"-DIA. HOLE AT CENTER OF EACH PIECE, 3" IN FROM THE END. JOIN EACH CORNER WITH A 1/2 x 4" GALVANIZED CARRIAGE BOLT.



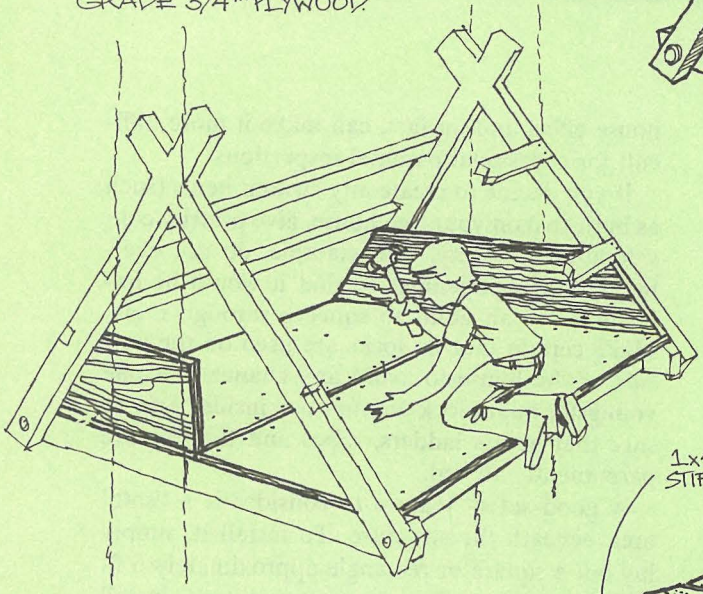
NOTCH BOTH PIECES OF 2x4 AT THE TOP OF THE TRIANGLE 6" FROM THE ENDS, SO THEY FIT INTO EACH OTHER TO FORM A FLUSH JOINT. THEN BORE A 5/8"-DIA. HOLE THROUGH THE CENTER OF EACH NOTCH AND SCREW-FASTEN TRIANGLE TO THE TREE WITH A LAGSCREW. AT LEAST 1-1/2" OF THE LAGSCREW SHOULD PENETRATE THE TREE.

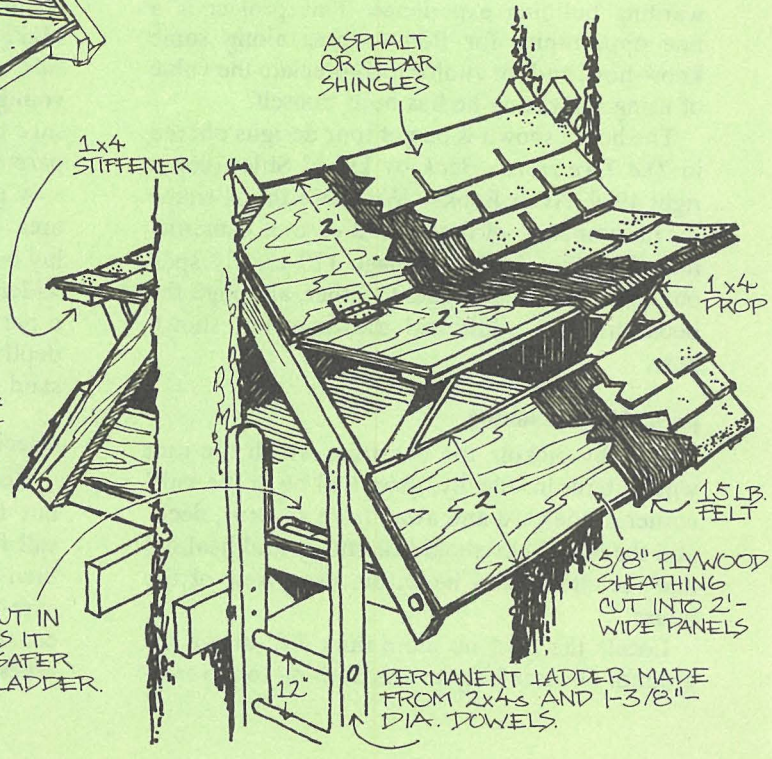
IF THE TRIANGULAR FRAME DOES NOT REST VERTICALLY (PLUMB) AGAINST THE TREE, MAKE A SPACER BLOCK FROM SCRAP 2x4 AND WEDGE IT BETWEEN THE FRAME AND THE TREE.

2 FRAME THE STRUCTURE AS SHOWN USING 2x4s FOR FLOOR JOISTS AND 2x3s FOR THE WINDOW FRAME.



3 FLOOR AND END PANELS ARE CUT FROM TWO SHEETS OF EXTERIOR GRADE 3/4" PLYWOOD.

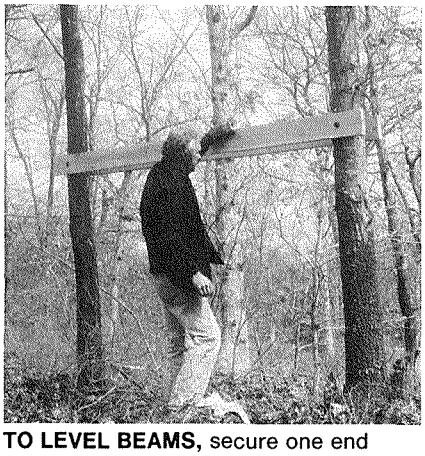




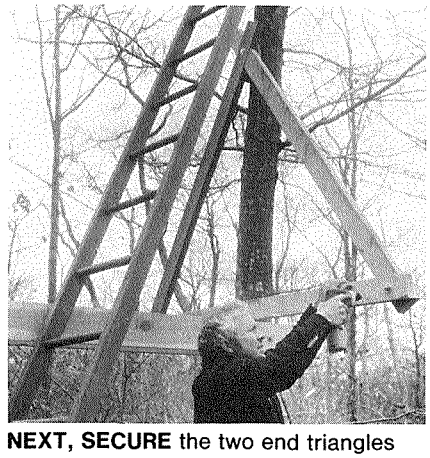
4 THE ROOF IS MADE FROM THREE SHEETS OF EXTERIOR GRADE PLYWOOD. RIP PLYWOOD DOWN THE MIDDLE TO CREATE SIX PIECES

HAND HOLD, CUT IN FLOOR, MAKES IT EASIER AND SAFER TO CLIMB UP LADDER.

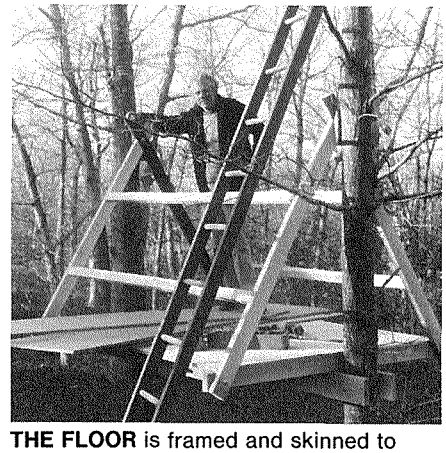
IN HIS A-FRAME plan detailed here, David Stiles keeps the construction super-simple to hold down the cost. His tree-house book features three other basic designs in addition to the A-frame shown. For the safety of the children, be sure that you pick two healthy trees of adequate size and that you anchor tree house securely.



TO LEVEL BEAMS, secure one end with lagscrew and swing board up until level. Mark tree, secure second end with lagscrew.



NEXT, SECURE the two end triangles to tree and beams.



THE FLOOR is framed and skinned to provide a safe working platform so that the work on the A-roof can proceed.

and the house will be a visual asset in most back yards.

The roof and the floor should be skinned with exterior grade plywood. Although the drawings call for ⅝-in.-thick material, ½ in. is adequate and using it will save you a few pennies. The roof should be covered with 15-lb. felt followed by either asphalt or a layer of wood shake shingles.

The floor can be left as is as long as the plywood edges are protected from moisture. (Even exterior-grade plywood will delaminate eventually if left exposed to the weather.)

building the A-frame

Start by measuring the distance between the chosen trees and cut the pair of 2 x 6s for the beams. Locate and bore the shank holes for the lagscrews in both ends of both boards. (Note: The shank hole should allow the screw to pass through easily; i.e., use a 9/16-in. bit for a ½-in. lagscrew.)

Position the first end of the board at the correct elevation and use the prebored hole to locate the screw position on the tree. Bore the pilot hole in the tree to receive the screw. Have a helper hold the board firmly in position while you install the lagscrew.

Slip a washer on the screw before passing it through the 2 x 6. Do not tighten the screw fully at this time; leave the screw loose enough so that the board can be swung up and leveled.

While your helper holds the board level, mark the second tree for the second lagscrew. Bore the pilot hole and install screw as before. Repeat the procedure for the second 2 x 6, making certain it is level with the first one. There should be at least 1½ in. of lagscrew embedded in hardwood trees and 2½ in. in softwood trees. Finally, turn all four lagscrews tight.

making the triangular ends

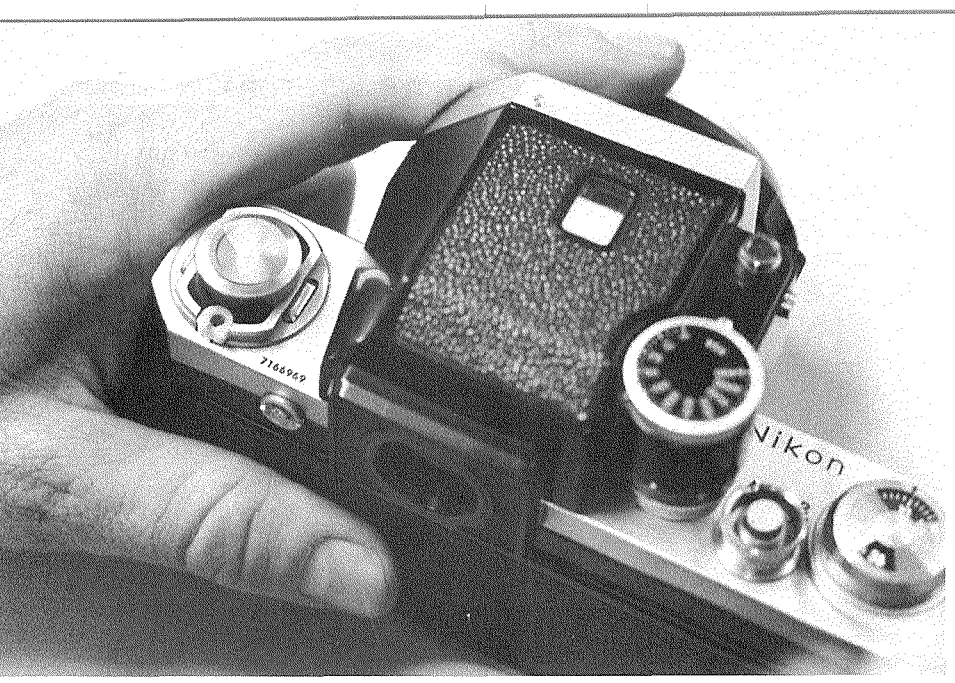
Next, build the two end triangles. It is easiest to assemble these on the ground; then install them on the beams. For this, you *must* have a helper; there is simply too much weight for one person to hold steady while locating and boring screw and bolt holes. Notice that all frame assembly is with lagscrews and carriage bolts; since they are exposed to the weather, use only galvanized hardware.

If both end triangle panels are built accurately, they will be perfectly level when set upon the main beam. While both panels are still on the ground, carefully align them and mark both for positioning on the beam.

With end panels installed, the floor can be framed and skinned with plywood. This way you will have an ample deck to work upon while completing the house. Install floor joists using 12d galvanized common nails spiked through header joists into joist ends. Add several toenails through joists into the beams. Horizontal roof rafters are installed by spiking through the rake rafters on the ends.

Cover the roof with plywood and shingles, build the ladder and install. Designer Stiles suggests leaving the house window- and door-less to maintain a "welcome" attitude to neighborhood kids. If you install windows, make them of a sheet acrylic, such as Plexiglas, to avoid any accidents.

Artwork on the facing page is from The Tree House Book, copyright © 1979 by David Stiles, and is reprinted by permission of Avon Books.



1 NO FILM in the camera. Few goofs can cause more embarrassment than this one, but it happens all the time, even to professionals. Jon Naar recalls the time he happened upon a raging fire at a hotel in London. He whipped out his Leica and began shooting. Many of the "exposures" were highly dramatic, but the camera wasn't loaded. He and many other pros always watch the rewind knob to see if it turns when the film-wind lever is advanced (see photo, left). A related problem can also be solved this way: Sometimes the film is loaded but doesn't advance. If the knob moves, you're okay. Don't be afraid to waste a frame making sure the film is moving—it's worthwhile insurance.

6 photo mistakes even the pros make

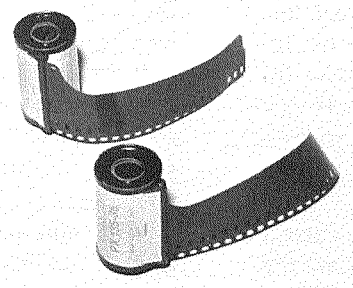
By TOM SAHAGIAN

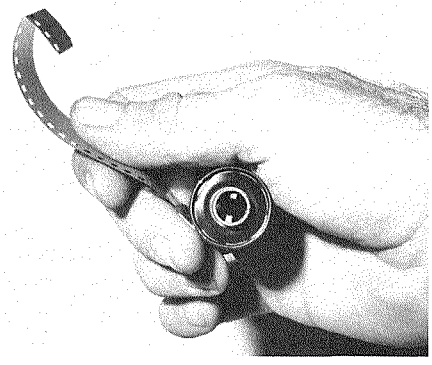
PROFESSIONAL PHOTOGRAPHERS are human; they make mistakes. But since a pro can't goof too often and remain a pro, he usually devises a system to make sure errors don't recur.

Amateurs need not worry about some of the more esoteric boo-boos the pros make, and many photos are ruined by failures in the camera. Such mechanical foul-ups occur more often in equipment that sees everyday use—and sometimes abuse—by a working pro than in amateur gear used twice a month.

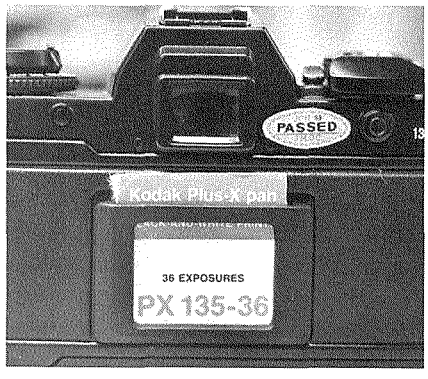
We've selected six of the most basic blunders that everyone makes. If you acquire the habit of going through a mental checklist each time you shoot, you'll minimize your goofs.

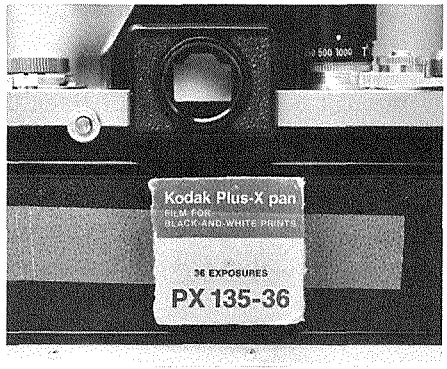
2 RESHOOTING a roll of film. Many photographers, especially those who do their own processing, do not rewind the film all the way into the cassette. That way, they can squarely cut off the narrow leader strip in the light before winding the film on a developing reel. But you need a way to distinguish between used and unused film. In the photo at the near right you can't tell which roll has been exposed. You could easily reshoot the used film. Solution: Crimp the end of the leader after rewinding (far right).





3 WRONG FILM-SPEED setting. With today's 400 ASA films many photographers just set the film-speed dial at 400 and forget it. But what's more likely is that you'll shoot color slides at ASA 64 one day, and then perhaps "push" 400 ASA to an exposure index at 800 indoors the next. It's easy to forget to change the dial. The best thing to do is to tape the end flap from the film box on your camera back (far right) as a reminder. Some cameras now have holders made specifically for an end flap (near right).

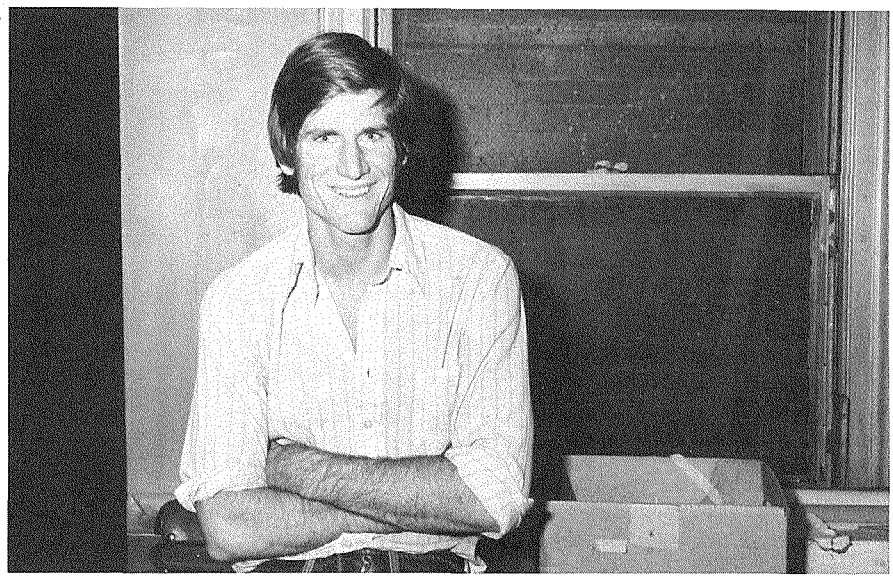


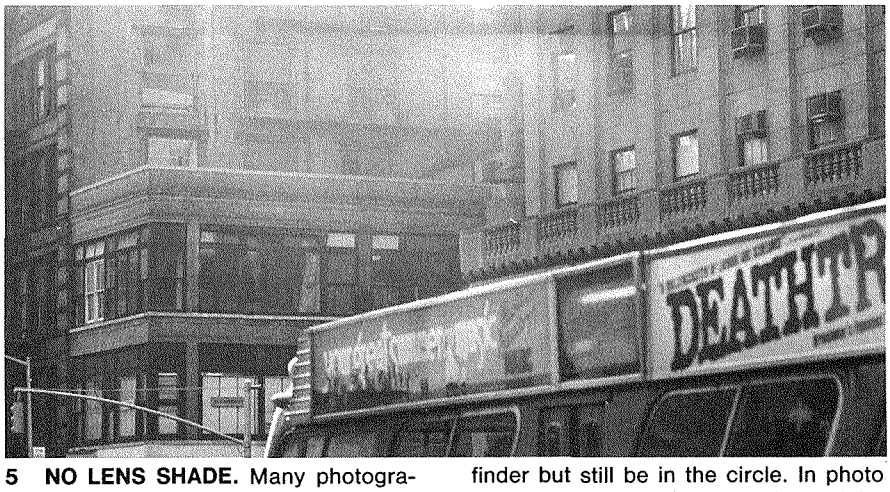


4 INCORRECT FLASH synchronization. This is a common problem because modern flash units are so automatic it's easy to forget that the shutter speed still must be set for proper synchronization. That is, the shutter must open fully as the flash fires. On cameras with focal-plane shutters, proper electronic flash sync is 1/60 or 1/125 second. Cameras with leaf shutters can sync up to 1/500 second.

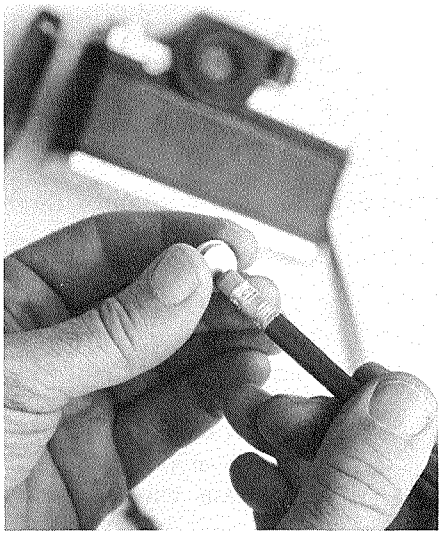
At shutter speeds above proper sync, part of the frame will be unexposed (right) except for the ambient light. With some cameras the entire negative will be black. A small label affixed to the flash unit reminding you to set sync speed should do the trick.

What happens if you set too slow a sync speed? Not much, unless you shake the camera.



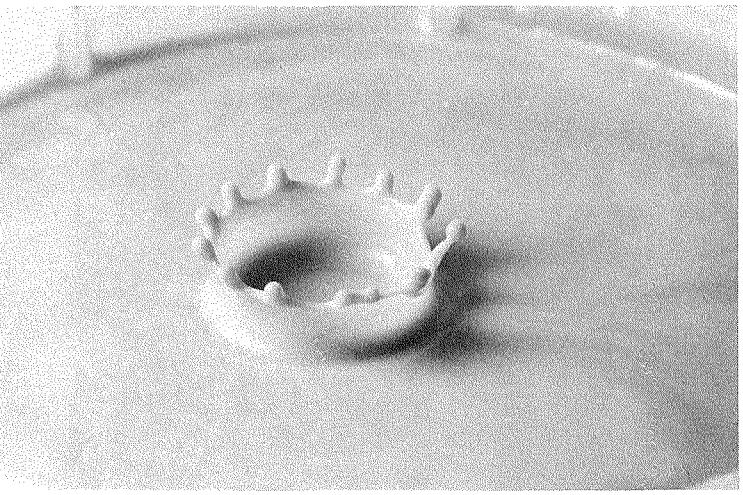


5 NO LENS SHADE. Many photographers neglect to use lens shades because they think the anti-reflective coating on modern lenses renders a shade useless. Not so. Unwanted light rays can spill into the image area and cause washing out or spurious reflections. Note that even though image area is rectangular or square, lens projects a circle. A bright light may not be visible in viewfinder but still be in the circle. In photo above, no shade was used. Much of the top is washed out, even though the sun was not visible in the viewfinder. In photo below, a shade was used. Details are much clearer. When lens is stopped down, little hexagons or octagons can appear in a photo; these are reflections of the lens diaphragm. Often a shade on a lens can eliminate these.

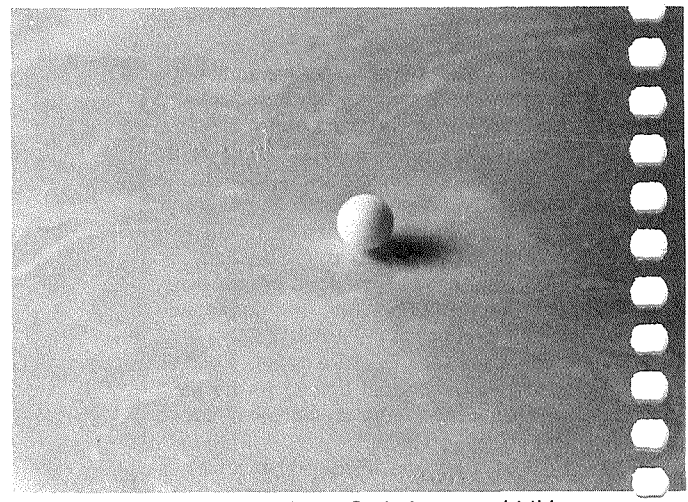


6 LOW BATTERIES. As cameras become more and more electronic, and as motor winders proliferate, more camera systems depend on batteries. Some manufacturers have incorporated flashing LEDs or other warnings to tell you when batteries are running low. Even so, it's possible to be caught with your energy down. Carry a fresh set with you at all times. Some photographers have two sets of nicads and keep one set always on the charger. Others wrap batteries in a plastic bag and stick them in the freezer. After taking them along as a backup, they are returned to the freezer to prolong life.

If you still manage to become stuck without a backup, here's a possible way to squeeze another shooting session out of a battery: Clean its contacts with a pencil eraser (above). Wipe with a cloth to remove fingerprints and reinstall without touching the contact surfaces.



CLASSIC MILK-DROP splash was captured with an SLR and ordinary automatic flash.



QUICK REFLEXES and a Morse Code key caught this drop before splash. Note surprising spherical shape.

Stop the action!

By ARMAND ENSANIAN

You can use your automatic flash to freeze the fastest subjects

REMEMBER Harold Edgerton's classic milk-drop photographs? When he first developed high-speed photography, Edgerton needed a raft of complex, expensive equipment to take the pictures that made him famous.

Today, anyone with a camera and a $30 automatic flash unit can take similar high-speed photos.

An SLR or 2¼ camera will make picture taking easiest, but any camera (instant, rangefinder, 110) will work, as long as it has a provision for holding the shutter open for a few seconds; this usually means it has a "B" setting. Some auto-exposure cameras will stay open long enough if fired in total darkness. Also, the normal lens of the camera should be able to focus at least as close as 3¼ feet; you've got to be able to bring the camera near the subject to fill the frame. A telephoto lens will help, but you'll lose depth of field.

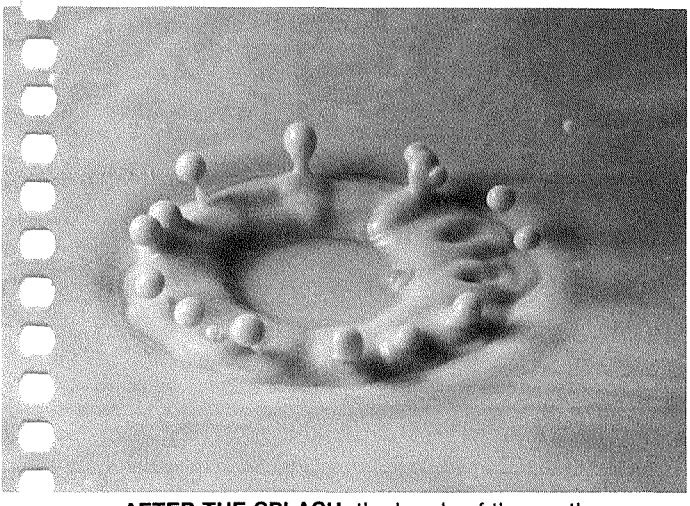
The flash can be any automatic unit; more expensive models have shorter flash durations. Some models that cost less than $100 have durations as short as 1/50,000 second. A manual flash is no good because flash duration is fixed and too long.

Numerous subjects lend themselves to high-speed photography. Some obvious candidates like bullets bursting balloons are too hazardous, but the famous milk splash, with its beautiful crown, poses no danger. It can be photographed two ways.

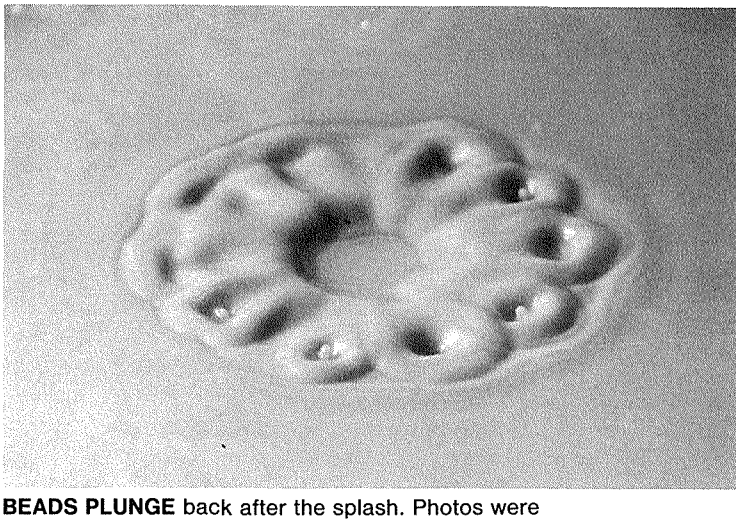
The first requires quick reflexes. Pour enough milk into a plastic dish to completely cover the bottom. Secure a milk-filled eye dropper about 16 inches above the center of the dish and focus the camera on the point where a drop will splash. The flash should be at its minimum working distance from the splash (consult your manual).

In subdued light, hold the shutter open, release a drop and trigger the flash just as the drop hits the milk. The flash can be fired by its own test button, or by a switch connected to an adapter with a PC connector at one end and a female household plug on the other (widely available in photo stores). One of the best switches to use is a cheap Morse Code key; it permits quick firing. This method is particularly useful for capturing the drop just before it splashes (see photo above).

A nearly foolproof method is more complex, but still easy to construct. Tape a strip of aluminum foil inside a shallow plastic dish. Then tape a similar strip to a 1 x 1-foot piece of plastic food wrap. Stretch the wrap over the lid so that the strips face one another and almost touch. Then tape the edges to the table. A smaller plastic lid with a 1-inch hole cut in the center should rest on



AFTER THE SPLASH, the beads of the gentle crown are shown briefly suspended in mid-air.



BEADS PLUNGE back after the splash. Photos were taken by varying tension on a rigged "switch."

the plastic wrap; add milk as before.

Attach wires to the foil strips and connect them to the flash trigger (preferably with the PC/household plug adapter). The gap between the foil strips should be about the thickness of a sheet of paper. Test it by blowing on the milk; the flash should fire. The force of the drop hitting the milk should close the foil switch and fire the flash. To capture different stages of the splash's formation, adjust the tension of the plastic wrap by placing small weights on it outside the rim of the dish. More weight will pull the strips farther apart and postpone the flash firing.

With both methods, it is necessary to keep flash duration to a minimum. To do this, use coat-hanger wire to fashion a stiff support for a piece of 8 x 10 tracing paper (or wax paper). Position this paper about 6 to 8 inches in front of the flash unit. The paper reflects enough light back to the auto sensor to keep flash duration short, but passes enough light to illuminate the subject. The paper also diffuses light and reduces harsh shadows.

Because the flash is the sole light source and the shutter must be open a fairly long time, it's important to work in light that's as dim as possible—perhaps even under a safelight (be careful with a safelight when shooting color film). The shooting sequence goes like this: Focus the camera, cock it, set the flash trigger, charge the flash, douse the lights, open the shutter, fire the flash, close the shutter.

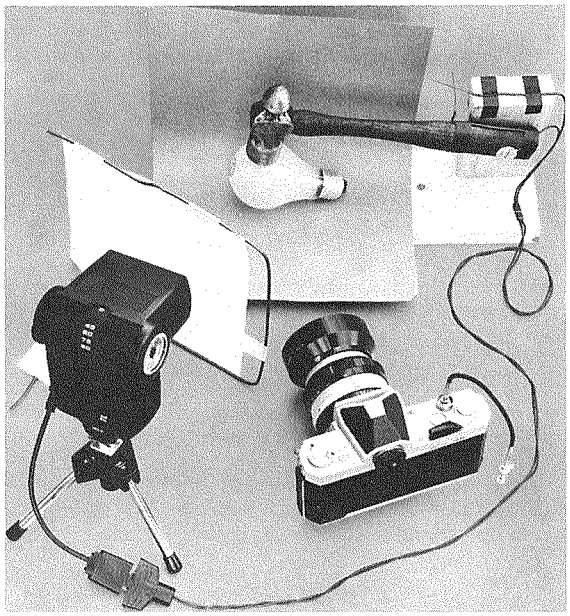
The ultrashort flash duration will lower the effective speed of the film, because most films are designed for shutter speeds between 1 and $\frac{1}{1000}$ second. This phenomenon, known as reciprocity failure, must be adjusted for by increasing exposure about one step.

Further exposure adjustment must be made for light loss caused by the tracing-paper reflector; an extra ½-stop increase should do the trick. Therefore, if the flash's exposure dial calls for f/11, the aperture should be set between f/5.6 and f/8. Shoot a roll of film of a stationary subject (no milk drops, just the setup), and develop it before taking action shots to make sure the exposure is on target.

If the aperture can't be adjusted, develop the film as though it has been "pushed" one stop. For example, with 400 ASA film, shoot it at 400, but process it at 800. Use film at least as fast as 100 ASA. Slower film will rob you of precious depth of field.

Speaking of depth of field, you'll have to do a bit of a balancing act between the need for depth and the need for short flash duration. Choose the widest aperture (smallest numerically) that will provide enough depth of field for the scene you're shooting; the wider the aperture, the shorter the flash duration and the faster the action you can stop.

In the example of the hammer breaking the bulb (see photo, page 176), the trigger is simply two pieces of wire bent to touch each other at the desired moment. To build the trigger, fasten a wood block to a wooden base. Drill a hole in the end of the hammer handle and screw the hammer through the hole to the block so it can swing freely. Tape one piece of wire to the handle and one to the block. Glue or otherwise anchor a bulb



SETUP FOR the breaking bulb: Note the trigger wires, tracing-paper support and PC cord adapter. The camera should be a few feet away.

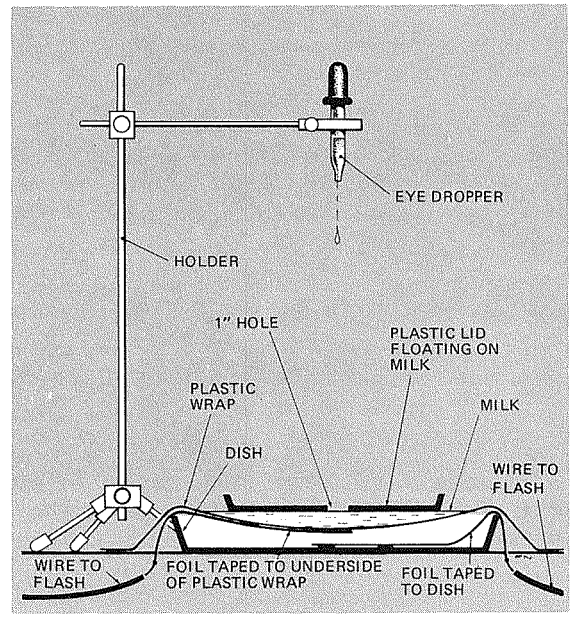
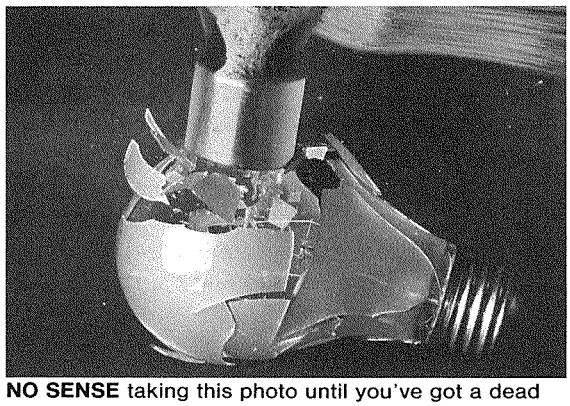
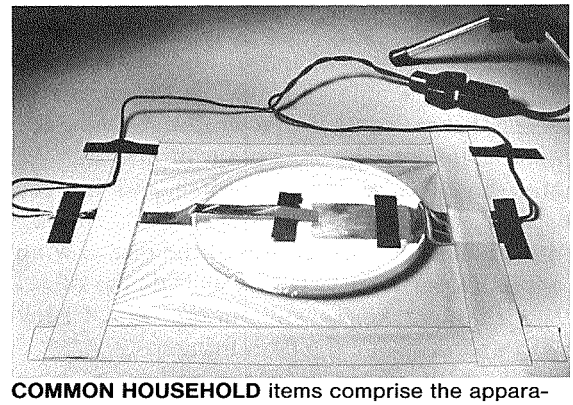


ILLUSTRATION SHOWS a cross section of the milk-drop arrangement. Dimensions have been exaggerated somewhat for clarity.



NO SENSE taking this photo until you've got a dead bulb around the house. By varying the trigger gap, different stages of breakage can be caught.



COMMON HOUSEHOLD items comprise the apparatus (shown without the milk or floating lid). Wires plug into PC-to-wall-plug adapter available at photo stores.

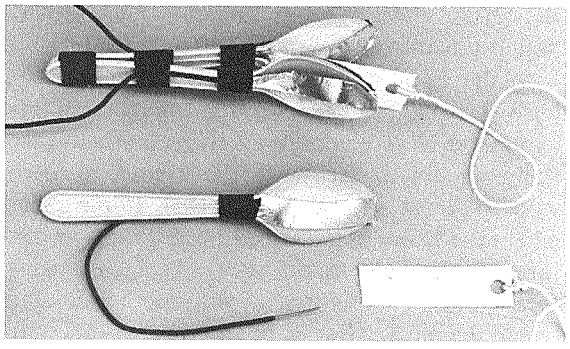
to a cardboard background of contrasting color and position it near the wooden base. Bend the wires so they touch just after hammer makes contact with bulb.

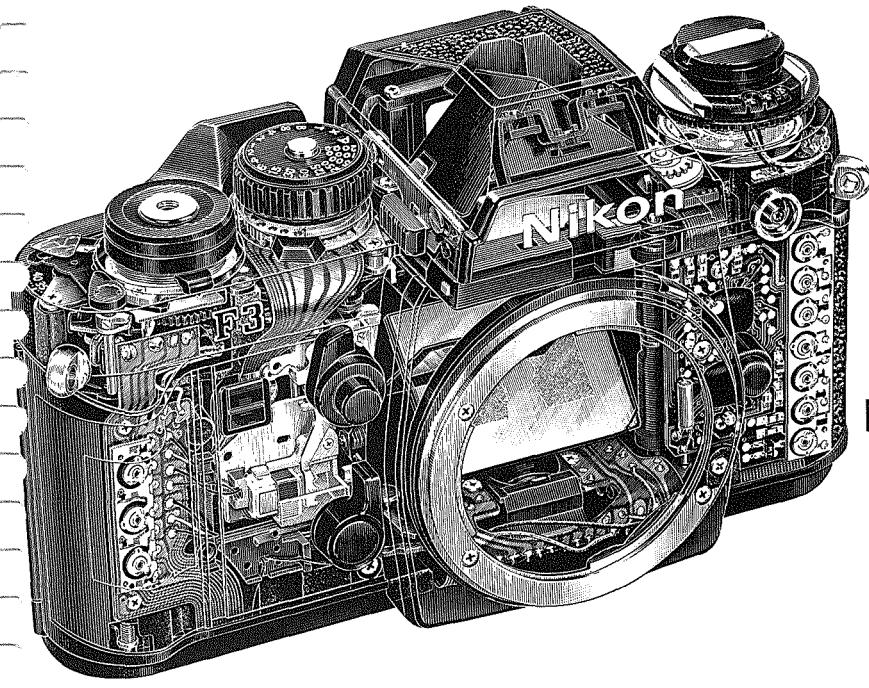
For safety's sake, it's wise to place a piece of glass between the bulb and the camera, and to wear goggles. The camera must be secure so it doesn't move during the exposure.

Place the flash at its minimum operating distance from the bulb, as before, and aim it at the center. Connect the wires to the adapter. Working in subdued light, as always, open the shutter, drop the hammer and close the shutter.

By all means, bracket your shots and take notes to establish perfect exposure and technique. The key to successful stop-action photography is trigger design. Possible configurations include tripwires, photocells and sound triggers. With ingenuity, you'll be able to capture a leaping animal, a baseball going through a window, or a cream pie plastering a friend's face. The latter may require some coaxing, but the photo will be priceless.

TRIGGER DEVICES can be made from string and plastic spoons. The pull spacer and foil strips touch.

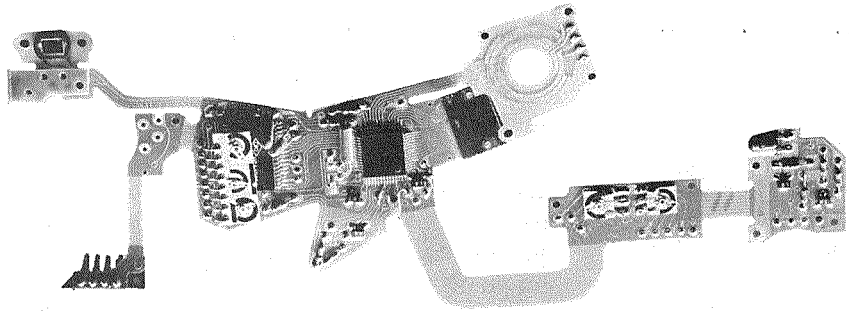




Automatic cameras: more versatile than ever

By IVAN BERGER

When they're combined with the new automatic flash units, the latest cameras eliminate most of the work of taking good pictures



CUTAWAY OF NIKON F3 (top) shows complexity of modern SLRs. Flexible printed circuit from Contax 139 (above) typifies the latest microcomputers.

CAMERAS AREN'T yet so automated that they tell your subject "Say cheese!" But the day when that will happen draws closer all the time. The newest cameras can not only control daylight and available-light exposure for you, but can let you choose how they'll control it. Not only that, various new models can:

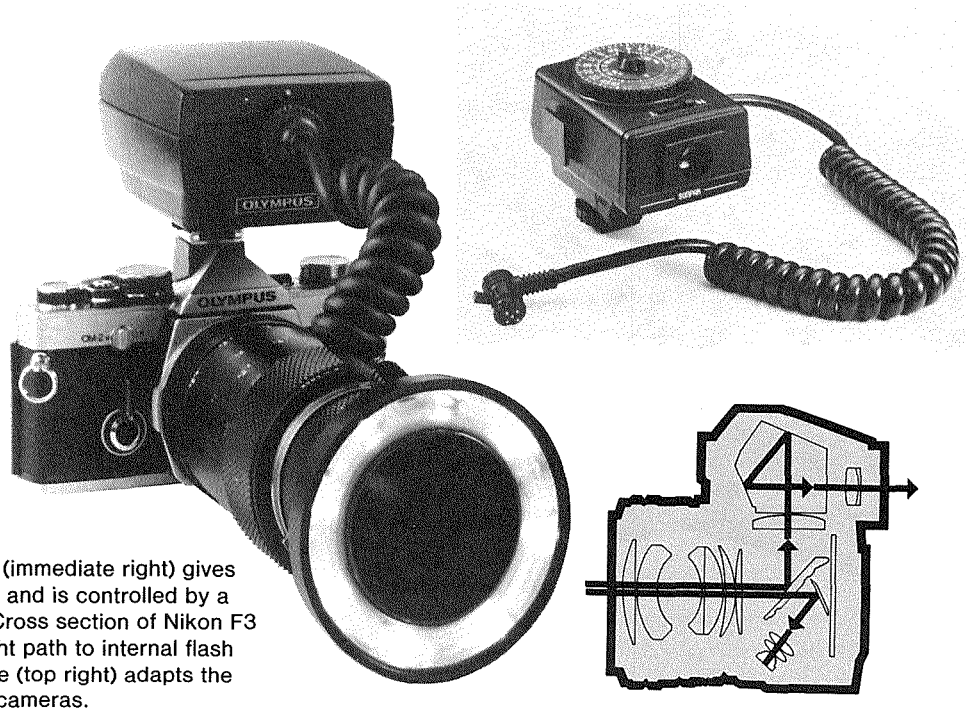
- Focus themselves.
- Beep when batteries are low.
- Beep when film is running out.
- Wind themselves.
- Print time and date on the film.
- Control flash exposure by keeping up a running dialogue between the camera and flash gun.

If that sounds like a computer at work, you're right. The new automatics have built-in microcomputers that are more powerful than earlier control systems.

computers keep prices down

The computers are helping to keep camera prices down while increasing reliability. Complex electronics, unlike complex mechanical control systems, are cheap to manufacture and assemble, which helps hold the line on inflation. (Other techniques, including the use of high-impact plastics, also help.)

Since solid-state electronics don't wear out the way mechanisms must, there's greater long-term reliability, too. But along with that come two short-term catches: Electronic components sometimes fail shortly after purchase (covered by warranty, but still a nuisance). And battery failure can put a whole camera—not just its metering system—out of commission, or at best, leave it limping along on only one or two shutter speeds. (Moral: Always check batteries before shooting and carry spares on trips.) But the most obvious benefit of computerized cameras is increased control-system versatility. Take flash automation, for example.



OLYMPUS RINGLIGHT (immediate right) gives even light for close-ups and is controlled by a sensor in the camera. Cross section of Nikon F3 (far right) shows the light path to internal flash sensor. Sun-pak module (top right) adapts the same flash to different cameras.

CHANGE SHUTTER speed manually on Pentax ME Super (top left) with two pushbuttons; no dial needed. Canon AF35M (top right) has autofocus, auto film advance and rewind. Fujica AX-5 (lower left) features dual-mode automation, two-head flash option. Mamiya ZE (lower right) couples lens to the auto system electrically.

what can go wrong

A lot can go wrong with flash. If the camera's shutter speed is too fast, part of the film won't be exposed while the flash is on. If you shoot before the flash has recycled, the flash will be weak or not go off at all. If flash output, subject distance and lens f-stop don't match, the picture will be too light or too dark.

Auto-flash guns, which measured the light bouncing back from the subject in order to know when to shut themselves off, were a partial solution to the last problem. But that still left room for error if you forgot to set the f-stop right—not to mention all the other problems. But new cameras—and "dedicated" flash units (designed to interact with specific camera models)— are taking care of all that.

multiple automatic corrections

On the Olympus OM-2 and OM-2n, the Contax 139 and 137 MD and the Nikon F3, the signal to shut off the flash comes from a light sensor in the camera reading the light bouncing off the film. That means there are automatic corrections for f-stop settings, filters, close-up extension tubes or bellows and any other factors affecting the light reaching the film.

What happens if the flash can't deliver enough light (if the distance is too far, or the f-stop too small, for instance)? Some of the new automatics will just keep their shutters open long enough to complete the exposure from the available light;

others will blink indicator lights in their viewfinders to warn you something is wrong. The same lights double as "ready" lights to tell you when the flash has recycled. If you try to shoot before the flash is ready, most auto cameras will simply shoot an auto exposure as if the flash weren't there.

Too fast a shutter speed? No problem. On most new automatics the unit will automatically set the camera's shutter to proper flash sync speed when it's ready to shoot—but will relinquish control to the camera while recycling.

dedicated flash systems

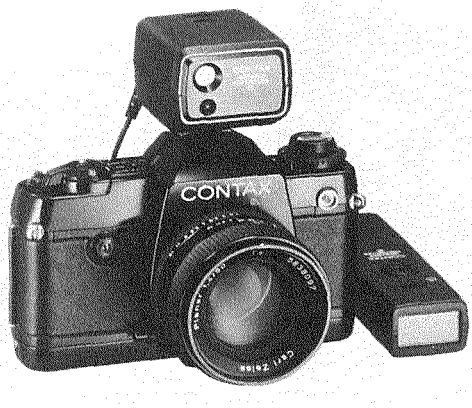
Just about every major camera manufacturer makes such dedicated flash systems for at least some of their models. You'll find units for Canon, Chinon, Contax, Fujica, Konica, Mamiya, Minolta, Nikon, Olympus, Pentax and Ricoh models. Those flash guns can't usually be used on cameras designed for other dedicated-flash cameras, though they can be used as ordinary auto-flash on other cameras.

If you have several cameras designed for different auto-flash systems, take heart: the Sunpak Auto 522, Auto 422D and Auto 222D and the new Mecablitz 60CT2 flash units have adapters available for dedicated use with most of the cameras listed above.

The Sunpak 522 and Mecablitz units both offer options that the camera makers don't match: a variety of power sources (Mecablitz even has a charger for use in the car) and telephoto range extenders (plus a small, umbrella-type reflector attachment for the Mecablitz).

Olympus's latest flash system is versatile, though. There are now three flashes in the system: the small T20; the larger, new T32, with built-in bounce; and a ringlight that fits around the lens for shadowless, close-up shooting.

CONTAX 137MD is shown here with an infrared remote controller. It also has a built-in power winder.



But what of all those other autocamera wonders? They're here in force. Take auto-focus, for example. Today, Canon, Chinon, Fuji, Konica, Minolta and Yashica have 35-mm compact cameras with autofocus, Polaroid has its two Sonar models, and autofocus movie cameras are available from Bell & Howell/Mamiya, Elmo and Sankyo, among others.

built in auto-winders

Polaroid's SX-70 and Pronto cameras were also among the first to have built-in motors to wind the film and, in the SX-70, to operate the reflex mirror. Now there are two 35-mm reflex cameras, the Konica FS-1 and the Contax 137 MD, with built-in auto-winders, and today add-on auto-winders are available as accessories for most 35-mm reflexes.

Motorization makes remote control more practical, too—you don't have to be there to wind the film between shots. Radio controls, good for distances of up to 300 yards or so, are now available from many manufacturers (even when marketed for a particular camera, they'll frequently fit others). And Contax has long had an infrared remote control which only operates over a 20-meter range, but which, unlike radio controls, can be used legally in any country.

Ever forget just where and when you shot your pictures? Today's cameras can jog your memory, too. Many 35-mm reflexes now can use accessory data backs that print the date or code number on the film as you shoot it.

built-in warnings

Today's cameras give you lots of information while you're shooting, too. Most of today's electronic models show you either which f-stop or shutter speed you're using, or both. Many also show flash status, warn of over or underexposure, and let you know when you've overridden the auto-exposure system to use a backlight compensator or go into manual mode, and when speeds are too slow for blur-free shooting. Contax's 137 MD even lets you see the frame counter while you're shooting.

Cameras don't talk, yet. But they're already making noises: Minolta, for example, has a 110 camera which beeps when light is low.

Chinon's 35F-M camera, a compact 35 with built-in winding motor, beeps when its battery is running low or film is running out.

With all the new talking appliances, the talking camera can't be too far behind.

Silence those nagging TV commercials

The next time a commercial interrupts your TV show, at least you won't have to listen. This silencer will shut off your TV's sound so it doesn't bother you.

By WALTER SIKONOWIZ

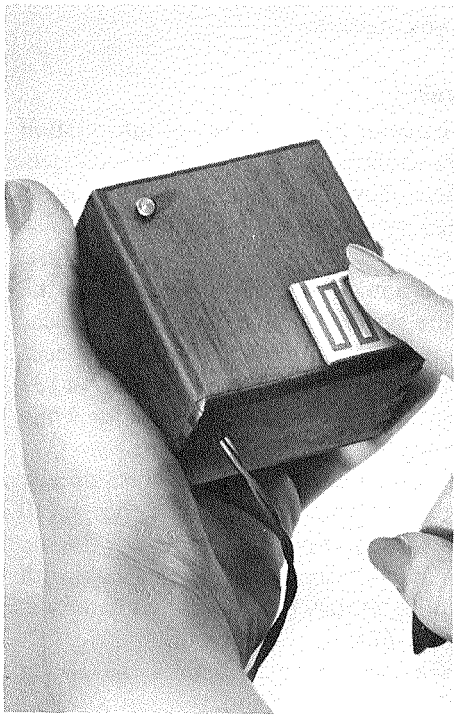
HERE'S A TYPICAL weekend scene: You're unwinding with a latenight horror movie. Inevitably, just as the vampire is ready to pounce, on comes something like a talking-tuna commercial to break the spell.

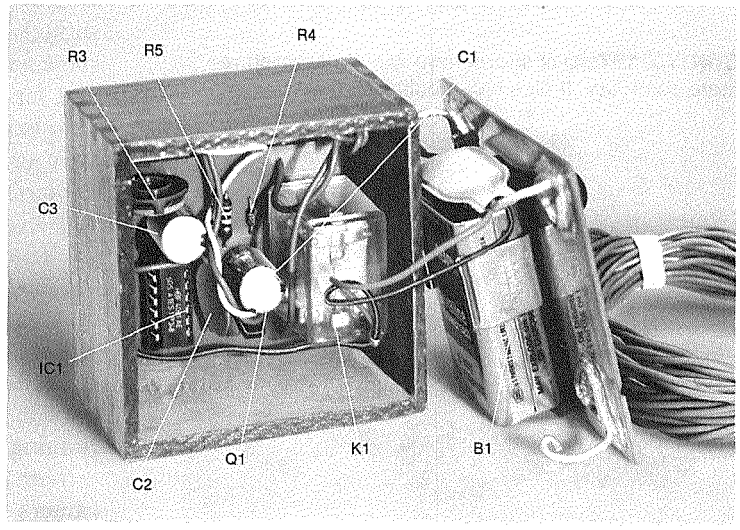
While there is little that can be done about the timing of such nuisance interruptions, it is possible to stifle them, using our Commercial Silencer. A light touch to the top of an innocuous-looking little wooden box sends the sound of commercials, extra-loud sportscasters, or whatever else, into oblivion for up to two minutes. At the end of that time, your television's audio returns to normal automatically. Construction is simple, and only a very slight modification of your TV is required.

More details on the Silencer can be found in the diagram (page 181). S1 is a touch-activated switch—basically, just a pair of metal plates in close proximity, but electrically isolated from one another. When a finger bridges the gap between the plates, a minute current flows from the 9-volt battery, through the finger (which acts as a resistor), and finally through R2, back to the battery. Our prototype switch is easily duplicated, using printed-circuit material. If you are not able to fabricate your own printed circuits, however, don't worry. Two strips of aluminum or copper, spaced 1/16 in. or so apart, will work equally well.

For the interval during which the Silencer remains activated, your TV will be silent, but its picture will not be affected in any way. The length of the quiet period is determined by R3, R4, C3. R3 allows adjustment of the timed interval to vary between 30 seconds and two minutes. TV commercial breaks are most frequently one minute in duration; however, some commercial periods are one-and-a-half or two minutes long. The prototype was adjusted to cut off sound for one minute. When necessary, longer commercials can be silenced with a second tap of the switch.

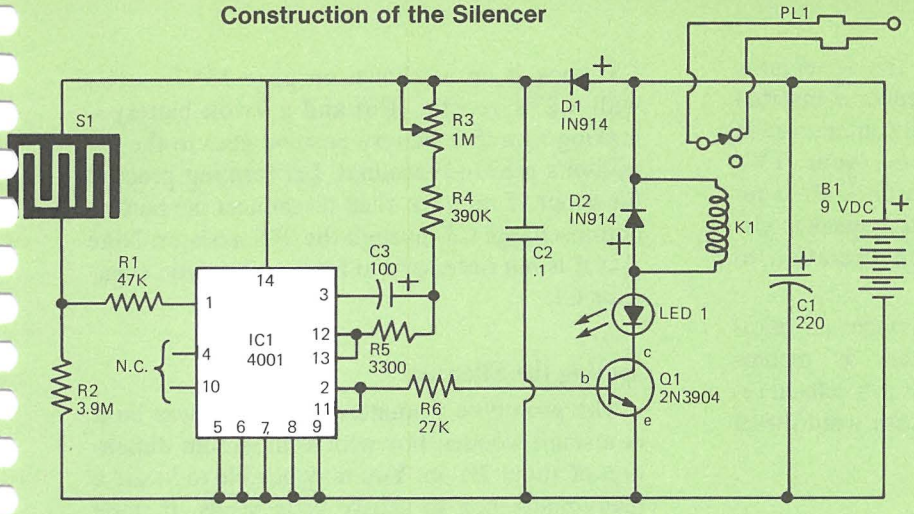
Modification of the TV requires that one of the two leads feeding your set's speaker—it doesn't matter which—be cut. A closed-circuit phone jack, J1, is then installed on the TV's back panel

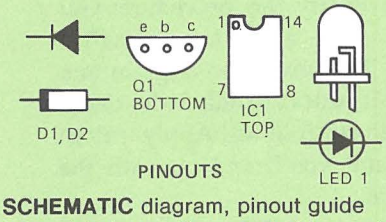




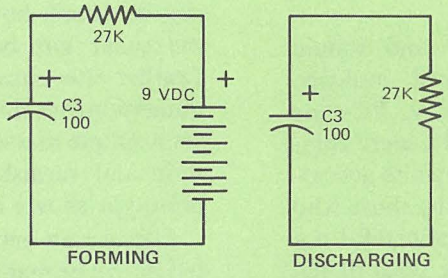
THE SILENCER (left and below) can be easily held in the palm of your hand. The red LED glows to alert you when it is on, but the welcome silence will also let you know.

Construction of the Silencer

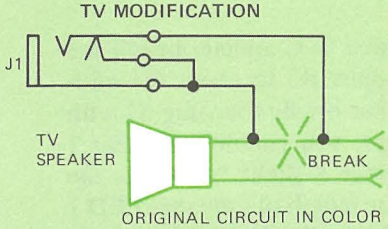


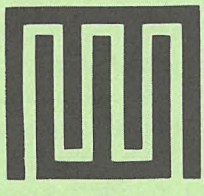


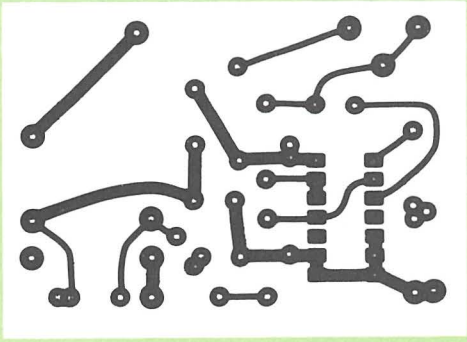
SCHEMATIC diagram, pinout guide (above) help you figure polarities and pin orientations as you build.



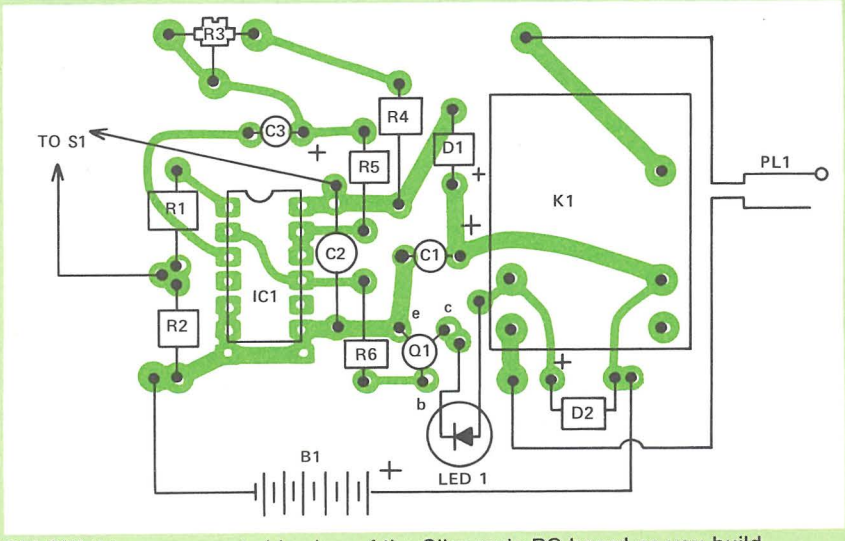
FOLLOW the instructions in the text for information on how to "form" C3.







BOTH SWITCH S1 and the PC board can be made from this template (above).



FOLLOW this component side view of the Silencer's PC board as you build.

PARTS LIST—SILENCER

B1—9-v. alkaline battery
C1—220-mfd., 16-v. electrolytic capacitor
C2—.1-mfd. ceramic capacitor
C3—100-mfd., 35-v. electrolytic capacitor
D1, D2—1N914 diode (Radio Shack 276-1122 or equiv.)
IC1—4001 CMOS quad NOR gate (Radio Shack 276-2401 or equiv.)
J1—¼-in. closed-circuit phone jack
K1—6-v., 500-ohm relay (Radio Shack 275-004 to fit our PC board template)
LED1—Light-emitting diode
PL1—¼-in. phone plug
Q1—NPN transistor, 2N3904 or equiv.
All resistors are ¼-watt and 10% tolerance
R1—47K resistor
R2—3.9M (megohm) resistor
R3—1M trimmer
R4—390K resistor
R5—3300-ohm resistor
R6—27K resistor
S1—Homemade touch switch (see text)
Misc.—Box, PC fabricating kit, wires, solder.

and wired in accordance with the schematic. Whenever plug PL1 from the Silencer is inserted into J1, relay K1's normally closed contacts are in series with the speaker; therefore, your TV's audio is under the Silencer's control. If P1 is removed, J1 automatically closes the speaker circuit, thus restoring normal audio operation to your set.

For long, maintenance-free service, an alkaline-type 9-volt transistor battery is recommended. Alternatively, six 1.5-volt AA cells in series could be used, but a bigger case would then be necessary.

silencer construction

Construction is straightforward and should pose no problems for experienced builders. While is is not absolutely necessary, PC-style construction will allow you to build a more compact circuit than perfboard. The layouts accompanying this article may be copied by those who desire a printed circuit; however, be careful not to confuse the foil and component sides of the board. Also, note that the PC pads for relay K1 are appropriate only for the Radio Shack device listed in the parts list. Other equivalent 6-volt, 500-ohm relays could be substituted, *but the PC layout would then need to be altered.*

For those choosing PC construction, S1 can be etched from a piece of single-sided phenolic board. One light wire should be soldered to each plate of the switch for later connection to the main printed circuit. On the other hand, if you elect to use aluminum strips for your touch switch, contact wires will have to be attached to soldering lugs, which can then be screwed to the aluminum plates.

IC1 is a device which can be damaged *easily* by either the a.c. current leakage from a soldering iron or a static discharge from your fingertips (especially in cold, dry winter air). So be careful installing it. When making all connections, it is important to use rosin-core solder, like Ersin Multicore or Kester 44. Acid fluxes are corrosive to copper. *Never* use them in electronic construction.

Before installing electrolytic timing capacitor C3, take the time to properly *form* it. "Forming" refers to the application of a d.c. voltage, in order to electrochemically deposit a complete layer of insulation between the plates of an electrolytic capacitor. While forming is not absolutely necessary, especially with brand-new electrolytics, it is recommended here so that there is no initial timing error after the circuit is constructed. To form C3, hook it up as shown on page 181 in series with a 27K resistor (R6) and a 9-volt battery—making sure that battery positive goes to the capacitor's plus (+) terminal. Let forming proceed for about 15 mintues, then disconnect the battery and discharge C3 through the 27K resistor. Note that it is *not* necessary to form electrolytic capacitor C1.

housing the Silencer

The prototype Commercial Silencer was built in a small wooden box with a maximum dimension of about 2½ in. You may be able to locate a ready-made box to satisfy your needs. If none can be found, however, try this procedure: Get the cedar gift box from a bottle of English Leather after-shave. The box is too large in one dimension, but since its sides are only ⅛-in. thick, it's a simple matter to cut it down. Apply walnut stain and varnish, and you'll end up with the prototype shown here.

Connection between your TV set and the Silencer can be made through a pair of thin, twisted wires running under a rug. Terminate the wires with plug PL1.

Once all construction is complete, install the 9-volt battery and adjust R3 to about the midpoint of its range. After briefly touching S1 with the tip of your finger, you should see LED 1 begin to glow and hear a slight "click" as the relay pulls in. Note the length of time that LED 1 remains on. Adjust R3 for the desired time interval. Touch S1 again and check time again. Repeat until desired cutoff time is obtained.

Although not shown on the schematic diagram, you may want to add a simple on-off switch to one of the battery leads. This can serve as a "bail-out" if you want to restore sound before the preset time has expired.

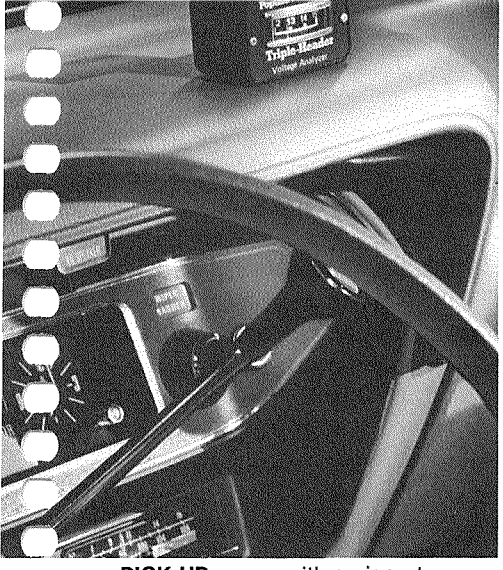
Finally, plug the Silencer into your TV and check to see that the sound is properly cut off when the circuit is activated. A few closing notes: First, do *not* use the Silencer to control the sound from a high-powered stereo system. Relay K1 is ideally suited to TV sets and table-model radios; however, an FM receiver in even a modest stereo system could damage K1's contacts at high volume.

A last note: *Be very cautious when you cut the TV's speaker wire.* That wire is not dangerous, but be careful not to touch or tamper with any other wires or components while cutting the speaker wire. Most servicemen can make the connection for you at a low cost. The unit will add to happy, peaceful viewing.

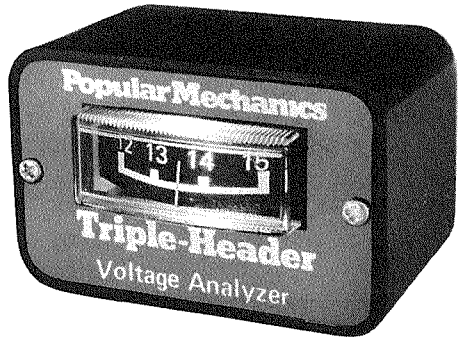
Build a 'triple header' auto voltmeter

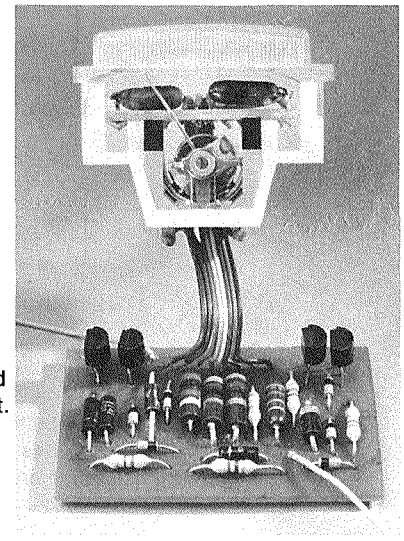
You don't have to read this gauge to figure out your car's electrical system. Glowing lights tell the story

By JEFF SANDLER



PICK UP power with a cigaret-lighter plug and you can move Triple-Header from car to car.





BEHIND the scale of the Triple-Header are red, green and yellow lights to signal changing electrical conditions. The lights must be on a PC board or wired behind the meter. For our PC board you'll need a meter separately available from the kit.

THIS TRIPLE-HEADER Voltage Analyzer touches all the bases in keeping track of your car's electrical system. It uses a meter and three traffic-light colors—a language anyone can understand.

The meter displays your car's voltage. Any malfunctions immediately move the voltage readings out of the normal range, and by noting "how" it happens, you will be able to diagnose exactly what component is at fault.

Relax and drive on when the scale shines green, because your electrical system is in good condition. Yellow is an early warning that trouble is on the way (we'll show you how to diagnose exactly what). Red tells you that there's little time left before you'll be stuck on the road.

A yellow or red glow indicates your car's energy budget is out of balance and the output of the generator or alternator doesn't match what is consumed by the lights, fans and other electrical devices. Your battery must make up the difference.

What you want to know is the exact moment that you're running on battery power. Fortunately, the switchover isn't so smooth it can't be measured. Once a battery is called on to put out (or absorb) power, its voltage changes "a little bit" as soon as the load is put on it. That's what sends the Triple-Header's needle flying on the scale and turns lights from green to yellow or red.

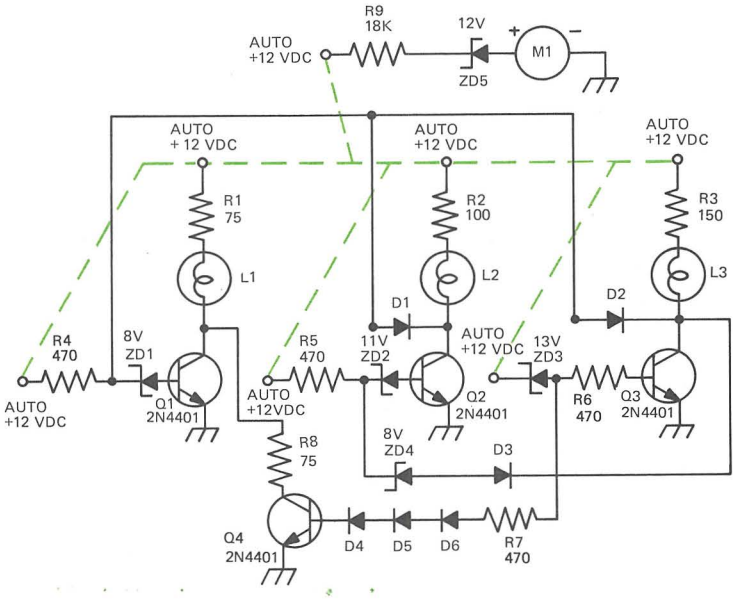
When you turn the key in the ignition, but don't crank the engine, there is minimal current drain on the battery. Essentially you get its open-circuit (resting) voltage. For a good battery you'll read this as 12.5 volts and the Triple-Header's scale will be glowing yellow.

But the instant you crank, hundreds of amps. are drawn from the battery for the starter, and the Triple-Header's red light glows and the scale shows 8 to 10 volts. This is the *only* situation where the red light doesn't mean immediate trouble. In this case, it's telling you that you have proper cranking voltage from the battery.

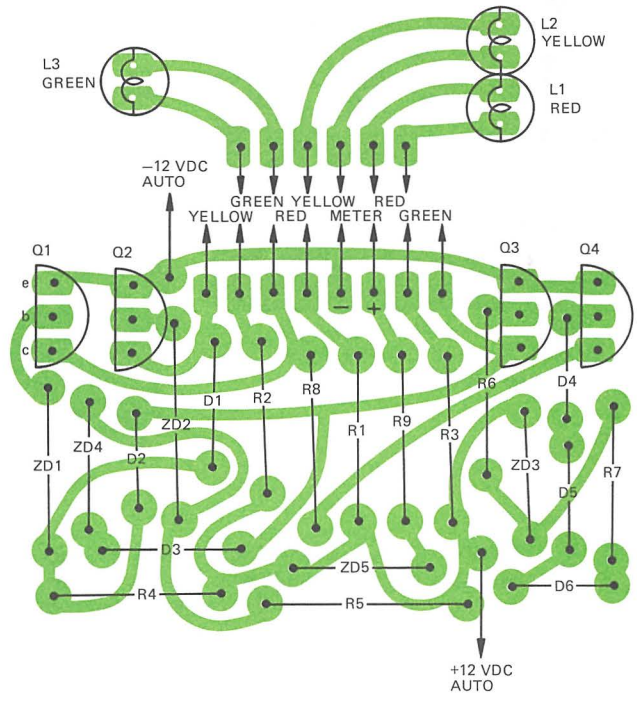
If, however, your car is hard to start—and you had a prolonged bout of cranking—the voltage would fall still further. All the lights would go out on the meter scale (under 8 volts), and then you would know your battery is running down.

Once the car roars to life, the voltage regulator tells the alternator or generator to turn out lots of power to bring the lowered battery voltage back up to the 13.7 to 14.7 range. It doesn't take long for the battery to take a quick charge. Usually, within a minute, you're back from the red, through the yellow and into the green range.

Triple-Header auto-voltmeter



AS SHOWN in the schematic and parts list, zener diodes are of varying ratings. These are critical values.



THESE component-side views will guide you in placing parts. Orient transistors as shown.

We hope that you never see anything different on your Triple-Header than what we just described, but if you do, here's what to do about it.

starting problems

You go to crank the engine and nothing happens—except the Triple-Header's meter glows yellow. This tells you the battery is over 11 volts, a voltage it never could maintain if it were putting out hundreds of amps. to crank the engine. Conclusion: The starter isn't receiving or drawing any current.

If the solenoid "clicks in," then the starter could have bad brushes or an open spot on the commutator and/or the connections to the starter could be corroded by road grime and salt. If the problem isn't in the starter, then the solenoid contacts are most likely worn out.

If the solenoid doesn't "click in," then either it is defective or the ignition wiring is bad. To find out which, bridge the solenoid as though you were going to "hot-wire" the car. If it cranks, the ignition switch or wiring is defective.

Another case: You crank the car and it turns over very slowly or not at all. All the lights on the scale are out, so you know that there's less than an 8-volt output coming from the battery.

Check the battery connections. If they're okay, then the problem is a dead, discharged or out-of-water battery.

running difficulties

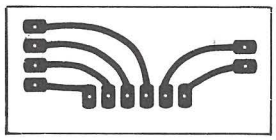
If the red or yellow lights glow when you are moving at highway speed, *immediately* check the fan belt. It's amazing how often it turns out to be the sole problem.

The meter falls rapidly and the red light eventually comes on. "Racing" the engine to get "extra power" from the generator/alternator doesn't slow the downward fall of the voltage one bit. Adding any electrical load (such as lights) accelerates the voltage fall.

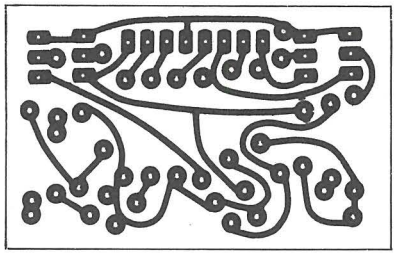
The battery supplies the total needs of the car. It's just a matter of hours (or less) until it is dead. Once that happens, you're stuck.

There are procedures for finding out whether it is your voltage regulator or generator/alternator that is at fault, but you have to check a service manual for your car to find the exact details.

Suppose that under light electrical loads the voltage stays in the 13.7 to 14.7 range, but it falls off sharply under heavy loads, and voltage snaps back when load is removed. What's happening is that when you exceed the limited capacity of the



USE these templates to make a meter PC board and a main board



generator/alternator, the car goes on battery power and the voltage falls.

If you have a generator, this situation generally results from bad brushes or a worn and dirty commutator. If you have an alternator, the brushes may be bad, or some (but not all) of the diodes may well be in poor condition.

overcharge

Both the Triple-Header's red and green lights glow at the same time during overcharging. This is the only situation where two lamps glow. The meter will be over 14.7, perhaps right off the scale.

Almost invariably the voltage regulator is at fault. Replace it; you'll avoid burning out light bulbs and shortening battery life to a great extent.

undercharge

The voltage is stable and well regulated, but at too low a level. You never get above 13.7 volts and the yellow light is on all the time. The lower the voltage, the more severe the problem.

Though nothing in the car is *likely* to be damaged, the battery will never get a full charge, and you may conceivably have some trouble cranking the car.

PARTS LIST—TRIPLE-HEADER

R1, R8—75-ohm resistor
R2—100-ohm resistor
R3—150-ohm resistor
R4, R5, R6, R7—470-ohm resistor
R9—18,000-ohm (18K), ¼-watt, resistor
Unless otherwise shown, all resistors are ½-watt, 5% tolerance.
L1, L2, L3—6-volt, 70-ma. lamps; red, green, yellow
Q1, Q2, Q3, Q4—2N4401 NPN transistor
M1—200-uA edge meter
D1, D2, D3, D4, D5, D6—1N4148 diode
ZD1, ZD4—8-volt zener diode, 400-mw.
ZD2—11-volt zener diode, 400-mw.
ZD3—13-volt zener diode, 400-mw.
ZD5 –12-volt zener diode, 400-mw.
Misc.—case (Pomona 2104); PC board materials; wire and ribbon cable; solder.
Note—A complete kit of parts is available from Circuit Craft Inc., 10 Idell Rd., Valley Stream, N.Y. 11580. Kit sells for $16.95, or completely assembled and tested for $24.95. Meter is available separately for $2.95.

Replacing the voltage regulator will cure this problem.

weak battery

As a battery gets older, its internal resistance rises and, as a consequence, it is less able to hold up its voltage under load.

Shut off your engine and then turn on the headlights. The voltage will fall about ⅓ to ½ volt. If it falls more, say a volt, it's probably getting old, particularly if the voltage drop is more than it used to be.

shorted battery

When one of the six cells is shorted or defective, the battery can't maintain its open-circuit voltage.

Make sure the battery is charged by riding with the Triple-Header showing green for a half hour or so. Then shut off the car for an hour. Come back and turn on the ignition. Do not crank the starter. If you don't get a meter reading, and the red light is on, it's likely you have a shorted battery, especially if the car won't crank.

dead battery

When you turn on the ignition without cranking, the voltage will be very low. Depending on how discharged the battery is, it could be anywhere from 0 to 12. Once you get the car started and run it for a while in the 13.7 to 14.7 range, the battery will recover rapidly. Within a day or two of normal driving, the battery will be back to normal.

glowing red—bad news!

The Triple-Header can spot those emergency situations which require immediate attention to prevent either engine damage or total electrical failure.

The red light comes on, and stays on (same as defective alternator) when you are moving along over 30 mph.

Stop the car right away to see if the fan belt is broken or loose. Usually, both the alternator and the water pump are driven by this belt. It won't take the engine long to overheat without the water circulating. If it gets hot enough, it can seize, and then you'll find yourself in the market for a new engine or, perhaps, even a new car.

But, even if the fan belt is at the proper tightness, you are still in big trouble. The car is running on the battery, and it won't last much longer before it is out of juice. Since the alternator isn't supplying anything when the battery gives out, your car stops dead (remember, the ignition coil runs on electricity).

New mini-TVs are entertainment centers

These tiny take-alongs offer more than TV on the beach. Some have AM/FM radios, cassette players, even shortwave receivers. And their picture quality is good!

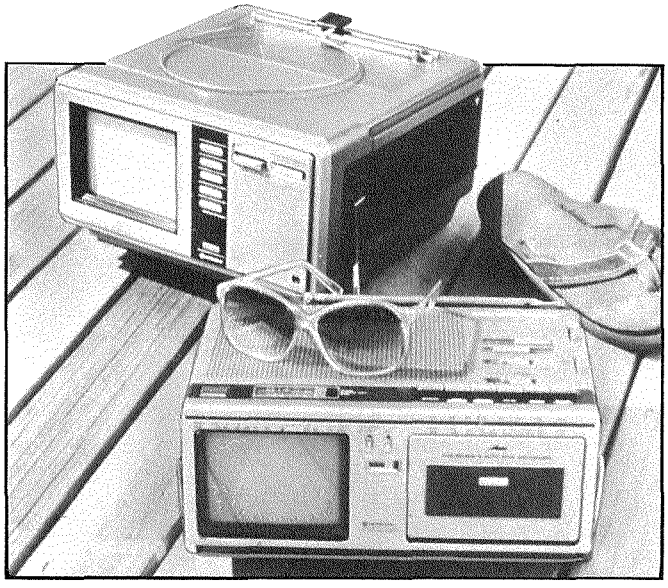
By NEIL SHAPIRO

TELEVISION SETS are smaller, more portable and offer far more extra features than ever before. These little sets, whose picture tubes measure only 5 inches or less diagonally, combine TVs with shortwave radios, cassette tape players, clocks and AM/FM receivers.

All the AM/FM tuner sections we heard sounded good. Even if there's nothing on the tube, you can still enjoy these TVs! The shortwave radios, however, were a different story. The built-in antennas are not sufficient for really good shortwave reception.

Brightness and clarity characterize these small sets.

BATTERY-POWERED, little TVs will take to the beach, so you can get a tan without missing your favorite shows. This young lady is watching a Unisonic model 967 color set with multiband radio and cassette recorder.

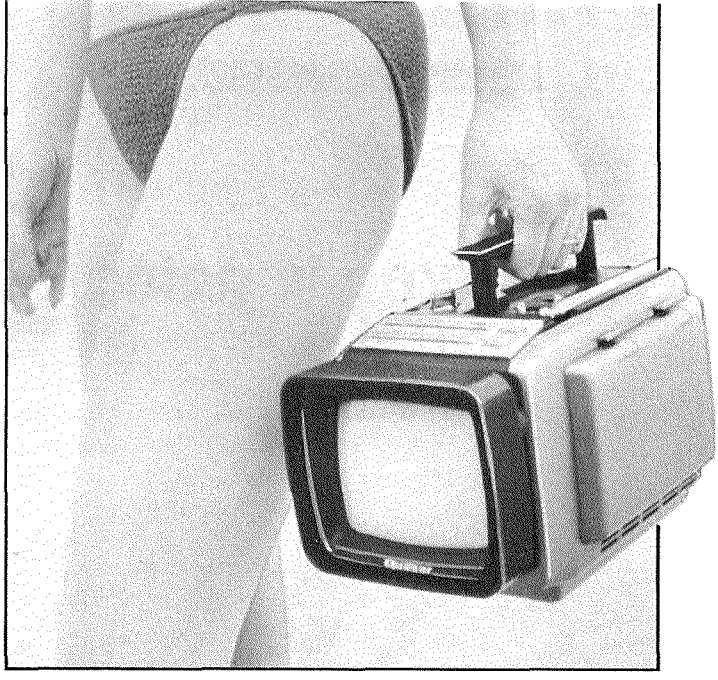


TWO ENTERTAINMENT centers from Hitachi are the color CK200 (top) and the black and white K/2400 (bottom). Both of them are battery portables, and the 2400 also has radio and cassette.

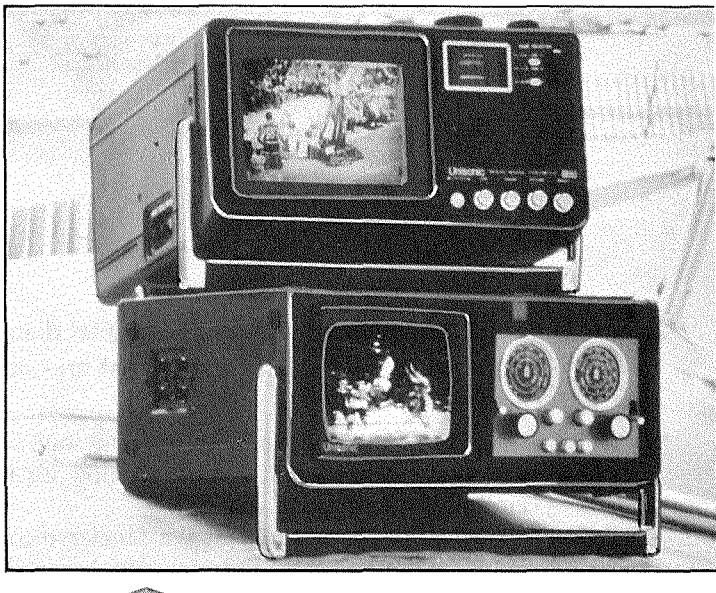
Even the smallest pictures are viewable, and some are remarkable.

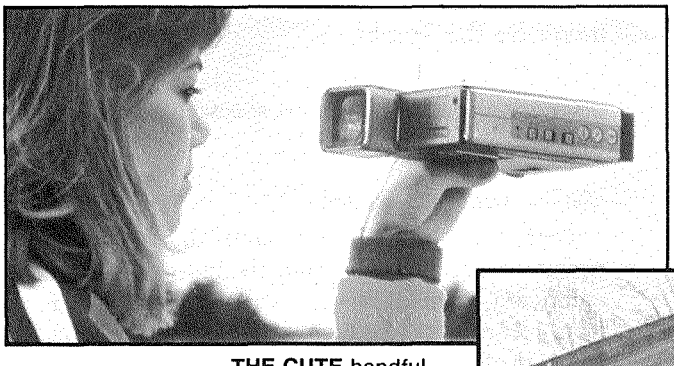
An engineer would call this brightness an illusion. The picture tubes are really no better than the big ones, but the dots that make up the picture, being compressed onto a smaller screen, appear to make brighter images.

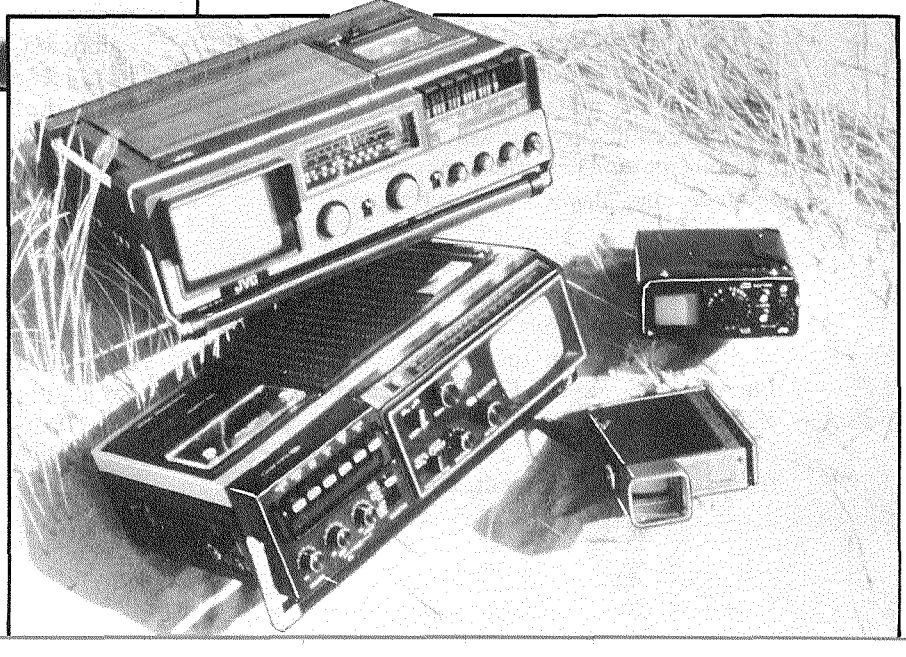
Sunlight will wash out the screens, however, so take along a good beach umbrella. (Due to the bright sun we had for our beach shots, we photographed the TV screens in a studio, and then stripped the pictures back into the sets.)



PART OF ITS "Toteable" series, Quasar's model XP145RJ (above) offers an AM/FM radio. Below are Unisonic's models 955 (top) and 927 (bottom). The 955 is a battery-powered color set, while the 927 is black and white, featuring a multi-band radio and a built-in cassette deck.







THE CUTE handful above is Panasonic's TRP-1000 TV with one-inch b&w screen and AM/FM radio. At right (clockwise from top) is JVC's CX500 color set with AM/FM and cassette; JVC's tiny P100AE with AM/FM and two-inch b&w screen; the Panasonic TRP-1000 also shown above; and Sampo's b&w model 8704 with AM/FM radio and cassette deck.

Stereo is going digital

By HANS FANTEL

A FULL-SIZE audio disc (above) is just over 4 inches in diameter, but it can reproduce better sound than any other existing medium. Its shiny surface is immune to fingerprints since the music is encoded in digital "pits" that are read by a scanning laser beam. An audio disc-playing deck from Philips (left) is much smaller than a conventional turntable.

Digital sound, both on the new digital disc and on specially prepared grooved records, is on its way to your home. It sounds great and audio will never be the same!

AS AUDIO swings into the '80s, the sound of the future can already be heard. By now it's for certain—stereo is going digital.

You can walk into any of the fancier record shops and, for anywhere from $8 to 15, buy a disc made with digital studio equipment. Granted, so far only a handful have been issued by such companies as London Records, Telarc, Denon and RCA. But more are on the way, setting new standards of fidelity and ushering in a new era of stereo. And soon even these may be outmoded by an audio disc played by a laser beam.

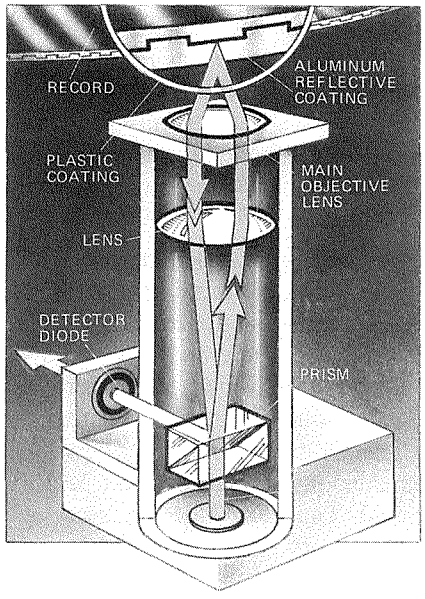
best recording ever made

For a stunning demonstration of what available digital recordings can do, try Telarc's version (DG-10039) of the Polovtsian Dances by Borodin or maybe London Records' "New Year's in Vienna" (LDR-1001/2), which mostly features the music of Johann Strauss. I know there's room for argument, but to my ears these discs are just about the most spectacular recordings ever made.

almost silent background

Every facet of the sound stands out as clearly as if it were etched in crystal, giving the music an emotional immediacy not normally experienced from recordings. The highs sparkle and the lows come through with an ear-boggling force that puts the bass drum right in the pit of your stomach. Add to this an almost silent background and the rock-steady pitch resulting from minimal flutter and wow on the record itself, and you get a notion why these new digital discs sound like nothing you've ever heard before.

And all that is just the first step in what has been called the digital revolution. For the present, digital technology is still confined to the studio. That's where analog-to-digital converters break down the audio signal from the microphone into digital bits to be recorded on a master



A DIGITALLY encoded aluminum coating on the disc reflects a beam of laser light. A diode then detects changes to produce the audio signal.

studio tape. The digital process—explained in detail later—provides far better sound definition at high- and low-frequency extremes, along with better signal-to-noise ratio.

This studio technique accounts for the superior sound of the discs now available under the name of "digital" records. But these discs in themselves are not fully digital—although such discs are on their way. In order to be played on existing turntables, digital studio recordings still have to be transferred to regular LP platters—and that's a bottleneck. The hitch is that not all the sound captured on the digital master recording can be squeezed into the narrow record grooves or tracked by conventional phono cartridges. The loud passages must be scaled down about 30 decibels to be tracked by present home equipment.

new disc and turntable

That's where the second step of the digital revolution comes in—a radically new kind of disc and turntable to make the most of all the possibilities inherent in digital sound.

Such devices are already on the way: They bring digital technology right into the home with a special record player, using a laser beam for a "needle." Two versions of the laser phonograph are now in the works—one by Philips and one by Sony. I listened to both. My reaction? Let's just say that outside of flesh-and-blood musicians I've heard nothing comparable.

Digital recording *does* mark the first fundamental switch from the recording principles worked out by Edison more than a century ago. Edison's method was analog; that is, the actual musical waveform was engraved into the recording—first through the primitive tin-horn and since 1925 through the microphone.

Even when tape recording came along later on, the analog principle was still followed: The magnetic patterns on the tape spelled out the shape of musical waveforms. In either case, the wiggly groove or the magnetized ribbon carried an actual image of the musical sound—the sort of waveform you would see if you "played" the audio signal on an oscilloscope screen.

distortion is natural

The trouble with this analog—or "imaging"—method is that distortion comes to it as naturally as dirt comes to a hog. On its journey from the microphone to the listener's loudspeakers, the signal gets mucked up every step of the way. The worst happens at the stylus tip. That little diamond chip has a terrible time keeping up with all those fast wiggles in the record groove.

And when the going gets really rough—as in loud passages or at extreme highs or lows—even the best phono pickup tends to cut corners in the groove path or overshoot the mark. The net result is rough, distorted sound. Tape can't take it, either. Loud signals cause magnetic overloads (distortion and loss of highs), and the soft sounds are swamped by tape hiss.

an audio marriage

Digital recording solves all these problems at a single stroke. Roughly speaking, digital recording can be described as the wedding of the computer with the phonograph—and from the sound of it, it's a good match. Computers have given audio engineers the basic clue to avoid the pitfalls of analog. The secret lies in "digitizing" the signal. The original sound, captured by the microphone, is fed to an analog/digital converter where every muscial frequency is encoded as a binary number intelligible to computer circuits.

As in most computers, these numbers are expressed as a series of pulses representing 1 and 0. That's why this system is also known as "pulse code modulation," or PCM for short. Gone is that tricky, wiggly analog waveform. Nothing is left but a fast data stream of digital "bits" to spell out the frequencies and amplitudes of musical sound. In the recording studio, these bits are recorded on tape just as information is recorded by digital computers.

The advantage is obvious. Translated into numbers, the signal becomes immune to distortion and noise. The numbers are precisely defined and permit no distortive ambiguity. The numerically defined waveform can't be altered by faulty groove tracking or amplification.

What's more, the musical "information" becomes independent of the material on which it is recorded. In other words, the surface has no effect on the sound. And if you've ever gritted your teeth at noisy, dusty or scratchy records, you can easily appreciate what this means in terms of sheer listening pleasure.

recording with light

To "cut" a digital record, the pulsing signal is used to modulate a laser beam that burns tiny pits into a swiftly rotating master disc. The sequence of pits and blank spaces represents the "zeros" and "ones" of the digital information. Once the master disc is cut in this way, copies can be pressed, just as in the case of ordinary phonograph records. This is a fast, inexpensive process, which makes the basic cost per disc (not counting the cost of the musical performance) low enough to compete with standard phonograph records.

In playback, the process is reversed. A small, solid-state laser—the crucial part of the digital phonograph—shines its beam on the spinning disc. Each pit and each blank space then reflects the beam back in a different manner. The reflections are projected through prisms into a light-sensitive detector diode which—like the light meter on a camera—converts the incident light into electric impulses. The varying reflections thus reproduce the digital signal, because each pit counts as 1 and each blank space as 0. The numbers thus recaptured are reconverted to analog form to drive the final amplifier and speakers.

mirror keeps laser on track

The playback laser beam must be precisely aimed and focused on the spiral of pits on the record. To compensate for any record warp or off-center pressing, a special mirror monitors the beam's reflections. Linked to a precision servo-controlled drive, it keeps the laser "on track"—aligned with the spiral pit pattern—somewhat like an autopilot keeps a plane on course.

no contact with disc

Laser scanning has an enormous advantage over the mechanical scanning done by conventional phono cartridges. There is no direct contact with the disc at all. The only thing "touching" the record is the light beam, which causes no wear whatever. For all we know, digital discs may last forever. As one engineer pointed out, they are the most durable "archival" medium ever devised. Anything digitally recorded will outlast any other mode of message preservation—even engraved stone, which eventually crumbles with age.

The digital disc also makes obsolete all kinds of fussy record care. No more brushes and chemical cleaners—and you needn't hesitate to lend your records to fumble-fingered friends. The disc is coated with hard, translucent plastic. Scratches, dust and fingerprints on this coating have no effect on the sound because the laser beam searches out the information *beneath* this plastic shield. The beam doesn't "read" surface blemishes. It "sees" right through them to the digital information below.

The Philips disc is only 4½ inches in diameter and no thicker than a dime. A dozen of them would slip easily into your pocket. The laser player is correspondingly compact, much smaller than conventional LP turntables. Sony uses a standard 12-inch record, which carries 2½ hours of music compared with one hour on the smaller Philips disc.

disagreements on standards

Technically, the digital phonograph is ready for the market, but it's not about to become a household item just yet. What's holding it up is the lack of agreement on technical standards. Before the digital format makes economic sense, discs and players all over the world would have to be compatible—just as standard stereo LPs are today.

But setting standards is a tricky task because of commercial rivalries. Each company is pushing its own system in hopes of getting it accepted internationally, then collecting license fees from everyone else. Digital politics are so tangled (especially in the United States where standards must be formulated without violating antitrust laws) that we may yet have to wait a couple of years for all-digital home delivery of recorded music.

Meanwhile, however, we can enjoy digitally recorded sound on standard LPs. Granted, such records still have to cope with problems like surface defects and groove-tracing distortion. But the new digital studio process gives even the present discs a big margin in fidelity, far ahead of anything the recording industry has been able to produce so far.

Index

The page number refers to the first page on which specific information can be found.

A

Alarm: propane-gas danger, 145
Ammunition: .22 cartridges, 146
Appliances
laundry, upstairs closet, 54
lock for plugs, 126
soundproofing, 46
Attic: made into family room, 57
Auger: cleaning bit, 114
Automobiles
fiberglass repairs, 106
gasohol, tips on using, 88
new gear, accessories, 150
towing with compacts, 136
voltage analyzer, 183
Avalanche probe, 142

B

Bandsaws: circle cutter, 116
Basement: waterproofing, 95
Bar: patio, latticework, 44
Bed: roll-out, under couch, 57
Benches
four-board bench, 158
workbench, craftsman's, 90
workbench, junior-size, 90
Boating
canoe, cedar-plank kit, 148
canoe, Kevlar fiber, 148
fiberglass boat repair, 106
inflatable boats, 140
trim tabs, 5 types, 134
Boilers: getting more heat, 83
Bolts: wall-fasteners guide, 109
Bread-cutting board, 158

C

Cabana: prebuilt, aluminum, 72
Cabinets
kitchen, building, 63
mobile tool cabinet, 123
shop storage cabinet, 194
Calendar, perpetual: for desk, 19
Calorie counter: digital, 148
Cameras
film-speed reminder, 172
flash shutter speed, 172
lens shades, using, 172
low-batteries, tips on, 172
new automatics, 177
no-film reminder, 172
Camping: new accessories, 145
Candle sconces, 21
Candlestand table, 158
Canoes
Kevlar Aramid fiber, 148
kit, cedar-plank 148
Ceilings
kitchen, recessed, 63
soundproofing, 46
Center finder: for boards, 122
Chairs
child's desk and chair, 16
"Tinkertoy," for kids, 158
Chimneys
how to sweep, 80
installing, 57
Christmas: gifts to make, 158
Circle cutter: bandsaw jig, 116
Clamps
custom-clamp kit, 126
gluing cross-clamps, 126
gluing miter joints, 116
Clock: digital alarm, auto, 150
Closets
door, latticework, 45
laundry, upstairs, 54
Clothing: for winter sports, 142
Coffee table: of oak, 158
Couch: has roll-out bed, 57
Cradles: plywood, two to make, 8
Crossbow: telescopic sight, 148
Cultivator: high-wheel tool, 74
Cupola: how to build, 37

D

Decks
bar, latticework, 44
lattice enclosure, 42
railing joint, 117
Desks
built-in, 57
child's crayon-box desk, 152
child's desk and chair, 16
Doors
latticework, 45
soundproofing, 46
Dowels: holes in miter joint, 115
Downspouts
runoff drainpipe, 95
snap-together, 71
Drains: for basement windows, 95
Drawers: kitchen cabinets, 63
Drill presses
making round ends, 114
miter dowel-holes, 115
Drills
bits, large-hole, 126
electric, heavy-duty, 126
pilot, adjustable, 126
Drywall: panel lifter, 126

E

Edger, lawn: duckbill, 74
Electrical extenders: plug-in, 69
Electrical plugs: lock, 126
Expansion bolts: fasteners guide, 109
Extenders, electrical: plug-in, 69

F

Faceplate: homemade, 117
Family room: made from attic, 57
Fasteners
plastic, make-yourself, 126
staple guns, using, 99
storage cabinet, 126
wall-fasteners guide, 109
Fertilizer spreader, 74
Fiberglass: patching, repairing, 106
Fireplaces
building a fire, 77
chimney sweeping, 89
slate hearth, 57
Fire starter: "bellows" tool, 126
Firewood: cheap sources, 76
Fishing
knots for new lines, 138
reel, fast-retrieve, 148
Flashlight: 10-year Moonlight, 150
Floors: basement, sealing, 95
Fountain: floats on pool, 72
Furnaces: getting more heat, 83

G

Gardening
cart, removable rails, 12
tools, hand-powered, 74
Gasohol: tips on using, 88
Gazebo: prefab, redwood, 72
Glass cutting: tools and how-to, 102
Gluing
cross clamps, 126
custom-clamp kit, 126
glue, fast-drying, 126
miter clamps, 116
super wood-glue, 126
Guns: new .22 ammo, 146
Gutters: snap-together vinyl, 71

H

Hammock: weaving from rope, 24
Hardware: shop storage cabinet, 104
Hoe, scuffle: two-way cuts, 74
Horse-on-a-stick toy, 158
Hot tub: 4-jet whirlpool, 72

I

Ironing center: built-in, 32

J

Joinery
deck-railing joint, 117
doweled miters, 115
miter clamps, 116

K

Kitchens
remodeling, cabinets, 63
soundproofing, 46
Knives: for outdoorsman, 148

L

Lamps
hanging lamp, plastic, 28
table lamp, plastic, 28
Lathe: faceplate, homemade, 117
Latticework: four projects, 42
Laundry: in upstairs closet, 54
Lawns
feeder, automatic, 70
tools, hand-powered, 74

M

Magnetizer: for tools, 126
Marking gauge: holds rule, 126
Mirror: contemporary frame, 158
Molding: concave, making, 115

N

Nails: wall-fasteners guide, 109
Noise: soundproofing home, 46

O

Outlets, electrical: extenders, 69

P

Painting
anti-rust coating, 126
latex floor enamel, 126
roller-paint tray, 126
rust inhibitor/primer, 126
Panels: modular latticework, 43
Patios
bar, latticework, 44
enclosure, latticework, 42
Photography
cameras, new automatics, 177
high-speed stop-action, 174
mistakes to avoid, 172
Pickup trucks
bed guard, 145
load braces, 150
Pipe, plastic: plumbing uses, 118
Plastics
fasteners, make-yourself, 126
lamps, made of plastic, 28
plumbing materials, 118
Plumbing
laundry in closet, 54
plastic materials, using, 118
soundproofing, 46
water-filter system, 70
Plywood: new rigid core, 126
Punches
hand, ton of power, 126
rotary, making, 125

R

Radial-arm saws
accessory cabinet, 123
rip fence, 122
Radio, auto: static stopper, 150
Railing: joint, using bolt, 117
Rake: picks up leaves, 74
Rolling pin, 158
Roofs, house: cupola, building, 37
Rotary punch: making, 125
Router: shaping curved edges, 114

S

Sabre saws: blade kits, 126
Saws, band: circle cutter, 116
Saws, radial-arm
accessory cabinet, 123
rip fence, 122
Saws, sabre: blade kits, 126
Sconces: candle fixtures
Screens, privacy: latticework, 42
Sealer, wood: clear finish, 126
Seeders
automatic, pogo-stick, 74
2-wheel, hand-pushed, 74
Shed: back-yard storage, 49
Shock absorbers: pump, 145
Shoes: for jogging, 148
Shower: camping, solar-heated, 145
Shutters
screens, latticework, 45
solid-panel, save energy, 85
windows, latticework, 43
Siding: metal-siding finish, 126
Skates, roller: high-top, 148
Skiing: new gear, accessories, 142
Sleds
backpack-sled, 142
mini-bobsled, 142
Snowshoes: buying guide, 132
Soundproofing: quieting home, 46
Spa: has waterfall, 72
Sparkplugs: lead puller, 150
Spotlight: quartz-halogen, 150
Sprayer, yard: hand-pump, 74
Sprinkler: lawn feeder, 70
Stairs: soundproofing, 46
Staple guns: buying and using, 99
Stereo: digital sound, 188
Stoves
building a fire, 77
chimney sweeping, 80
Sweeper, lawn, 74
Swimming pools: new pool products, 72
Switches, electrical: extenders, 69

T

Tables
candlestand, 158
coffee table, oak, 158
Television
commercial silencer, 180
mini-screen sets, 186
Tents
A-frame, 142
free-standing, no-pegs, 148
geodesic dome, 145
Thread restorers, 126
"Tinkertoy" chair, 158
Tires: chain installer, 150
Top: humming toy, 158
Towing: with compact cars, 136
Toys
clown pull toy, 158
horse-on-a-stick, 158
tools and toolbox, 158
top, humming, 158
tricycle, wooden, 158
Trailers
camping, folds, 145
compact-car towing, 136
folds to stow, 148
Tree house: A-frame design, 169
Tricycle: wooden, 158
Twist ties: dispenser, 126

V

VDO temperature gauge, 150
Voltmeter: for auto testing, 183

W

Walls
basement, sealing, 95
electrical extenders, 69
fasteners, guide to, 109
panels, latticework, 43
soundproofing, 46
Water-filter system, 70
Waterproofing: basements, 95
Weeder: 3-step tool, 74
Wind chill meter, 142
Windows
screens, latticework, 45
shutters, latticework, 43
shutters, solid-panel, 85
Windshields: repair kit, 150
Woodburning stoves
building a fire, 77
chimney sweeping, 80
Workbenches
craftsman's bench, 99
junior-size bench, 90
Workshops
in utility shed, 49
storage cabinet, 104
Wrenches
ratchet chain wrench, 126
socket set, 126

SCIENCE DIGEST

brings science to life...and, to you!

HALF PRICE OFFER!

Introducing Science Digest...where fact is more exciting than fiction! Crammed with news, up-to-the-minute discoveries and fascinating theories in all areas of science...from anthropology to ecology, to medicine to space to zoology—any discipline, any research, any field that affects you and your way of life, your way of thinking. And, it's written specially for you, the layman, to read with an ease, speed and clarity that scientific journals could only hope for.

Read Science Digest and become more interested and more interesting. You'll find it will stimulate your thoughts, widen your horizons and leave you mentally invigorated.

To subscribe to Science Digest, simply fill out the coupon to the right and send it to us, today.

Send to:
SCIENCE DIGEST
P.O. Box 10090, Des Moines, Iowa 50350

☐ YES! Please send me 10 issues of Science Digest for only **$5.99.** That's half the regular subscription price!

☐ I prefer 20 issues for just $11.97.

☐ My payment is enclosed (or) ☐ Bill me_____
initial here

Charge Orders Subject to Publisher's Acceptance.

Name_____
(please print)

Address_____

City_____ State_____ Zip_____

Your first copy will be on its way to you in 6 to 12 weeks. Watch for it!

Science Digest, $2.00 a copy. Regular subscription prices in U.S. and possessions. 10 issues $11.97, 20 issues $19.97. Canadian and foreign prices on request. Offer expires: 4/1/83. A Publication of Hearst Magazines, A Division of The Hearst Corporation.

Science Digest, 250 W. 55th Street, New York, N.Y. 10019.

W9PE

METRIC CONVERSION

Conversion factors can be carried so far they become impractical. In cases below where an entry is exact it is followed by an asterisk (*). Where considerable rounding off has taken place, the entry is followed by a + or a - sign.

CUSTOMARY TO METRIC

Linear Measure

inches	millimeters
1/16	1.5875*
1/8	3.2
3/16	4.8
1/4	6.35*
5/16	7.9
3/8	9.5
7/16	11.1
1/2	12.7*
9/16	14.3
5/8	15.9
11/16	17.5
3/4	19.05*
13/16	20.6
7/8	22.2
15/16	23.8
1	25.4*

inches	centimeters
1	2.54*
2	5.1
3	7.6
4	10.2
5	12.7*
6	15.2
7	17.8
8	20.3
9	22.9
10	25.4*
11	27.9
12	30.5

feet	centimeters	meters
1	30.48*	.3048*
2	61	.61
3	91	.91
4	122	1.22
5	152	1.52
6	183	1.83
7	213	2.13
8	244	2.44
9	274	2.74
10	305	3.05
50	1524*	15.24*
100	3048*	30.48*

1 yard = .9144* meters
1 rod = 5.0292* meters
1 mile = 1.6 kilometers
1 nautical mile = 1.852* kilometers

Fluid Measure

(Milliliters [ml] and cubic centimeters [cc or cu cm] are equivalent, but it is customary to use milliliters for liquids.)

1 cu in = 16.39 ml
1 fl oz = 29.6 ml
1 cup = 237 ml
1 pint = 473 ml
1 quart = 946 ml
= .946 liters
1 gallon = 3785 ml
= 3.785 liters
Formula (exact):
fluid ounces × 29.573 529 562 5* = milliliters

Weights

ounces	grams
1	28.3
2	56.7
3	85
4	113
5	142
6	170
7	198
8	227
9	255
10	283
11	312
12	340
13	369
14	397
15	425
16	454

Formula (exact):
ounces × 28.349 523 125* = grams

pounds	kilograms
1	.45
2	.9
3	1.4
4	1.8
5	2.3
6	2.7
7	3.2
8	3.6
9	4.1
10	4.5

1 short ton (2000 lbs) = 907 kilograms (kg)
Formula (exact):
pounds × .453 592 37* = kilograms

Volume

1 cu in = 16.39 cubic centimeters (cc)
1 cu ft = 28 316.7 cc
1 bushel = 35 239.1 cc
1 peck = 8 809.8 cc

Area

1 sq in = 6.45 sq cm
1 sq ft = 929 sq cm
= .093 sq meters
1 sq yd = .84 sq meters
1 acre = 4 046.9 sq meters
= .404 7 hectares
1 sq mile = 2 589 988 sq meters
= 259 hectares
= 2.589 9 sq kilometers

Kitchen Measure

1 teaspoon = 4.93 milliliters (ml)
1 Tablespoon = 14.79 milliliters (ml)

Miscellaneous

1 British thermal unit (Btu) (mean) = 1 055.9 joules
1 calorie (mean) = 4.19 joules
1 horsepower = 745.7 watts
= .75 kilowatts
caliber (diameter of a firearm's bore in hundredths of an inch) = .254 millimeters (mm)
1 atmosphere pressure = 101 325* pascals (newtons per sq meter)
1 pound per square inch (psi) = 6 895 pascals
1 pound per square foot = 47.9 pascals
1 knot = 1.85 kilometers per hour
25 miles per hour = 40.2 kilometers per hour
50 miles per hour = 80.5 kilometers per hour
75 miles per hour = 120.7 kilometers per hour

METRIC TO CUSTOMARY

Linear Measure

millimeters (mm)	fractions of an inch (to nearest 1/64″)
1	3/64-
2	5/64 +
3	7/64-
4	11/64-
5	13/64-
6	15/64 +
7	17/64 +
8	5/16 +
9	23/64-
10	25/64 +

Formula:
millimeters × .039 37 = inches

centimeters (cm)	inches (to nearest 1/64″)
1	25/64 +
2	25/32 +
3	1 3/16-
4	1 37/64-
5	1 37/32-
6	2 23/64 +
7	2 3/4 +
8	3 5/32-
9	3 35/64-
10	3 15/16-

Formula:
centimeters × .393 7 = inches

meters	feet (to nearest 1/4 inch)
1	3′ 3 1/4 + ″
2	6′ 6 3/4-″
3	9′ 10 + ″
4	13′ 1 1/2 + ″
5	16′ 4 3/4 + ″
6	19′ 8 1/4-″
7	22′ 11 1/2 + ″
8	26′ 3-″
9	29′ 6 1/4 + ″
10	32′ 9 1/2 + ″

Formula:
meters × 3.280 8 = feet
1 kilometer = 3280.839 8 feet
= .621 371 miles

Fluid Measure

1 milliliter (ml)	= .034- oz (fluid ounces)
10 ml	= .34- oz
100 ml	= 3.4- oz
1 liter	= 33.8 + oz
	= 2 pints, 2- oz
	= 1 quart, 2- oz

Formulas:
liters × 33.814 056 = ounces (fluid)
milliliters × .033 814 056 = ounces (fluid)

Weight

grams	ounces (avoirdupois)
1	.035 +
10	.353-
50	1.76 +
100	3.52-
500	1 lb 1.7- oz
1000	2 lb 3.3- oz

Formula:
grams × .035 273 99 = ounces (avoirdupois)

kilograms	pounds (to the nearest ounce)
1	2 lb 3 + oz
2	4 lb 7- oz
3	6 lb 9 + oz
4	8 lb 13 + oz
5	11 + lb
6	13 lb 4- oz
7	15 lb 7- oz
8	17 lb 10 + oz
9	19 lb 13- oz
10	22 lb 1- oz

Formula:
kilograms × 2.204 622 4 = pounds
1 metric ton (1000 kg) = 2 204.6 pounds

Volume

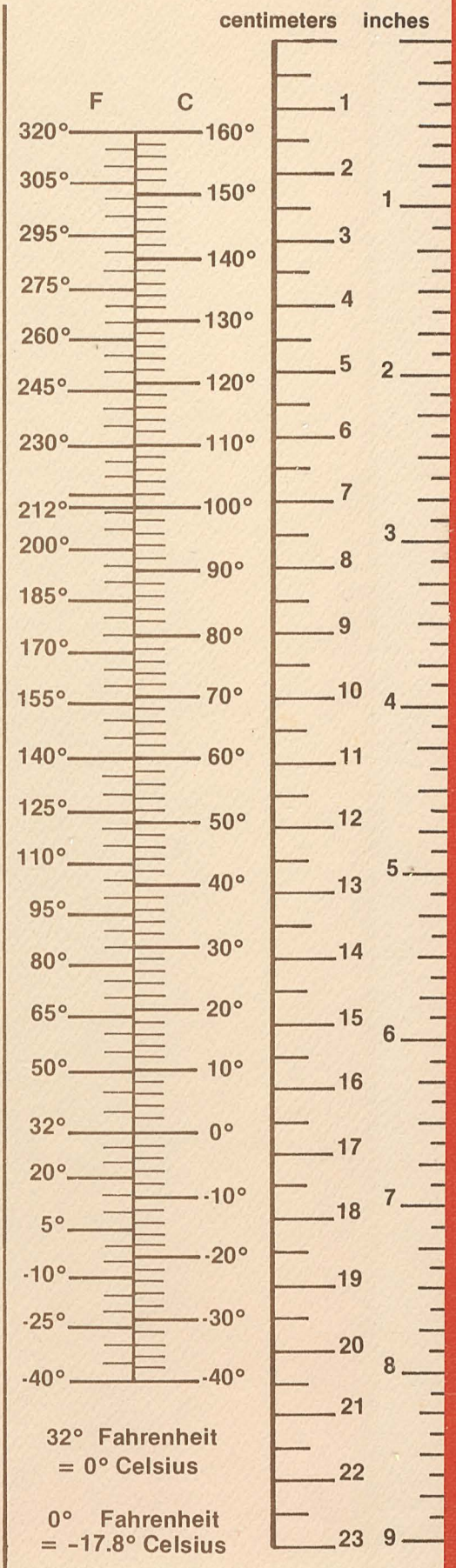
1 cubic centimeter (= 1 milliliter) = .061 + cubic inches
1 liter (1000 cc) = 61 + cubic inches
1 cubic meter = 35.3 + cubic feet

Area

1 square centimeter = .155 square inches
1 square decimeter = 15.5 square inches
1 square meter = 9.29 square feet = .84- square yards
1 hectare (10 000 sq. meters) = 2.47 + acres

Miscellaneous

1 newton (N) = 4.45- pounds of force
1 pascal (Pa) (pressure) = .000 145 + psi = .021- pounds per sq ft
1 kilopascal (kPa) = .145 + psi = 21- pounds per sq ft
25 kilometers per hour (km/h) = 15.5 + mph
50 km/h = 31.1- mph
75 km/h = 46.6 + mph
100 km/h = 62.1 + mph
Formula:
km/h × .621 371 = miles per hour



32° Fahrenheit = 0° Celsius

0° Fahrenheit = -17.8° Celsius